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**	Intelligent Systems and Control Engineering
2	**Programme Code**	ACSU04
3	**JACS Code**	H660
4	**Level of Study**	Undergraduate
5	**Final Qualification**	Master of Engineering with Honours (MEng Hons)
6	**Intermediate Qualification(s)**	Bachelor of Engineering with Honours (BEng Hons)
7	**Teaching Institution** (if not Sheffield)	Not applicable
8	**Faculty**	Engineering
9	**Home Department**	Automatic Control and Systems Engineering
10	**Other Department(s) involved in teaching the programme**	Computer Science, Electronic and Electrical Engineering, Mechanical Engineering and Management School
11	**Mode(s) of Attendance**	Full-time
12	**Duration of the Programme**	4 years
13	**Accrediting Professional or Statutory Body**	Institution of Engineering and Technology (IET), Institute of Measurement & Control (InstMC)
14	**Date of production/revision**	March 2024

15. Background to the programme and subject area

The degree in Systems and Control Engineering offers a general syllabus in systems and control engineering with an emphasis on control system analysis, design and implementation at both standard and advanced levels.

The application focus is on industrial systems, however the programme continually stresses the transferability of systems and control methods across non-traditional disciplines (e.g. complex biological processes, the economy and the environment). The programme focuses on the fundamental methods and technologies in a systems and control engineer's toolbox, primarily the analytical tools of modelling, analysis, design and optimisation, coupled with the practicalities of sensing, actuation and computer control). However, the programme also aims to develop sufficient knowledge of engineering science to facilitate adequate dialogue with specialist designers and to enable the specification of realistic performance requirements for the individual elements in a system.

The course uses teaching material from a number of other Engineering Disciplines and the Management School to ensure the students are exposed to a range of engineering areas and develop the necessary professional skills during their studies.

Graduates with a system and control engineering background are able to take employment in a range of industrial and non-industrial areas, and are in high demand. As a consequence, graduates from the Systems and Control Engineering course have a wide range of employment opportunities and excellent career prospects.

These programmes are accredited by the Institution of Engineering and Technology as satisfying the academic requirements for membership of the Institution and for Chartered Engineer status.

16. Programme aims

Programmes offered by the department are designed to fulfil the University's mission to provide high quality education for students from a wide variety of educational and social backgrounds. This is carried out in a research-underpinned environment, with staff working at the frontiers of academic enquiry. The specific aims of the Systems and Control Engineering programmes can be summarised as:

l To provide access to undergraduate degree programme in Systems and Control Engineering for students with a suitable level of academic ability.

2 To provide degree programmes that are accredited by professional institutions and provides part of the necessary education base required for students to attain the status of Chartered Engineer following additional academic study, appropriate postgraduate training and work experience.

3 To provide a range of alternative modules in the broader area of systems and control engineering in the later years to cover a diversity of student aspirations, within the constraints imposed by the requirements of programme accreditation.

4 To provide a range of advanced specialisation modules, in the area of systems and control engineering, in the last year to enable students to gain in-depth understanding on selected topics in systems and control engineering.

5 To provide students with teaching that is underpinned by the research attainment and scholarship of the staff.

6 To assess students over a range of generic and subject-specific skills.

7 To prepare students for a professional career in the field of Systems / Control Engineering, including the provision of suitable interpersonal skills.

8 To prepare students for a professional career in the field of Systems / Control Engineering, including the provision of project management, organisational, financial and other 'management' skills.

9 To provide experience in undertaking a substantial collaborative group design project.

10 To provide experience in conducting an advanced individual investigative project requiring substantial independent study.

17. Programme learning outcomes

Knowledge and Understanding: On successful completion of the programme, students will have knowledge and understanding of the:	
K1	fundamental principles of engineering science relevant to broad-based systems engineering.
K2	mathematics necessary to apply engineering science to systems engineering.
K3	analytical and design methods used in systems engineering.
K4	use of information technology for analysis, synthesis and design.
K5	knowledge and understanding of Control and Systems Engineering.
K6	advanced elective topics in control and systems engineering.

Intellectual Skills: On successful completion of the programme, students will be able to:	
I1	gather, organise and critically evaluate information needed to formulate and solve problems.
I2	analyse and interpret experimental and other numerical data.
I3	display creativity and innovation in solving unfamiliar problems.
I4	exercise independent thought and judgement demonstrated in a item of individual project work.

Practical Skills: On successful completion of the programme, students will be able to demonstrate:	
P1	skills in oral and written communications appropriate for the presentation of technical information and interaction with specialists in other areas of engineering.
P2	abilities in observation, measurement and the design and conduct of experiments through practical experience in the laboratory.
P3	skills in writing computer programs to perform analysis of engineering problems.
P4	the ability to use commercial computer software for analysis, synthesis and design.

General Transferable Skills: On successful completion of the programme, students will be able to:	
T1	demonstrate skills in personal organisation, time management and self-motivation.
T2	work collaboratively with others through the development of team skills.
T3	use IT tools effectively.
T4	the use of creativity and innovation in problem solving.
T5	communicate effectively, orally and in writing.

18. Teaching, learning and assessment

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

Lectures – these are used to deliver factual information on specific topics, explain theories and methods of analysis, synthesis and design.

Practical/Laboratory classes – students are organised into small groups (maximum of 3 per group) and follow prescribed experiments under close supervision in order to gain essential practical skills and to support lecture material.

Coursework assignments – these are individual exercises, often computer-based, in which the student is tasked with conducting a study, producing and evaluating results of the study and submitting a written report describing the work carried out.

Tutorials and problem classes – these are run for the whole class and provide a mechanism for more lecturer/student interaction than would normally be possible in a lecture. One major objective of these classes is to help students with the resolution of problems encountered in lectures and/or tutorial sheets that have been issued by the lecturer.

Individual investigative project – this is a study carried out over the final year of the programme. The project is supervised by a member of academic staff and normally enables the student to display initiative, creativity, attention to detail in the execution of the project. In addition, a project dissertation must be written which the supervisor and another member of staff examine. The student is also required to make an oral presentation at the end of the project.

Group design project - students are organised into groups (maximum of 5 per group) and follow a more open –ended experimental programme in which a design objective is prescribed but the precise mechanism for achieving the design is left for the group to determine.

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

Written examinations – when a module is assessed by written examination, these are unseen, timed assessments.

Coursework assessments – these are written assignments which can contribute in whole or in part towards the assessment of a module. For example, in the case of a laboratory-based module, 100% of the assessment may be via coursework.

Oral Presentations and Interviews – Students conducting the Individual Project are required to meet the second marker after one semester for an interview to discuss progress at an interim stage of the project. Students are also required to make an oral presentation of their project after submission of the dissertation.

Individual Project reports – a formal structured report documenting the project from inception to conclusion and including appropriate references, appendices and suggestions for further study. Both the supervisor and a second marker independently assess the dissertation.

Group design project – written reports compiled by the group undertaking the project on a shared authorship basis.

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 full text)	TEACHING / LEARNING						ASSESSMENT					
	Lectures	Practical classes	Coursework assignments	Tutorials /examples classes	Individual investigative project	Group Design Project	Written examinations	Coursework submissions	Class tests	Oral presentations / interviews	Individual project reports	Group Design Project
K1 Fundamental principles	*	*	*	*	*		*	*		*	*	
K2 Mathematics	*		*	*			*		*			
K3 Analytical / design methods	*		*	*	*	*	*	*	*	*	*	
K4 Information technology		*	*		*	*		*			*	*
K5 Subject specific knowledge	*	*	*	*		*	*	*	*	*		*
K6 Optional language skills	*		*				*	*		*		
K7 Advanced topics	*		*	*	*		*	*			*	
I1 Information gathering	*		*	*		*	*	*				*
I2 Analyse / interpret data	*	*	*	*	*	*		*			*	*
I3 Display creativity / innovation					*	*					*	*
I4 Exercise independent thought			*		*	*		*		*	*	*
P1 Oral and written communication		*	*		*	*	*	*		*	*	*
P2 Practical laboratory experience	*	*						*				
P3 Write computer programs	*	*	*					*	*			

P4 Use commercial software			*		*	*		*			*	*
T1 Personal organisation			*		*	*	*	*			*	*
T2 Collaborate in teams			*			*		*				*
T3 Use of IT tools					*	*		*			*	*
T4 Problem solving				*	*	*		*			*	
T5 Effective communication		*	*		*	*	*	*		*	*	*

19. Reference points

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

Mission Statement of the University of Sheffield, as presented in its Strategic Plan
http://www.sheffield.ac.uk/strategicplan

The Education Strategy of the University of Sheffield.

The appropriate qualification descriptors contained in the QAA Framework for Higher Education Qualifications in England Wales and Northern Ireland – August 2015.

The QAA Subject Benchmark Statement – Engineering, March 2023.

AHEP4, published in the Engineering Council reports: UK-SPEC (2020).

Feedback from Course Accreditation Panels representing the Institution of Engineering and Technology and the Institute of Measurement and Control.

The research interests of departmental staff and the research strategy of the Department of Automatic Control and Systems Engineering.

20. Programme structure and regulations

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

Student choice within the programme is constrained by the need to satisfy requirements set by the accrediting bodies for the course. It is therefore not possible to offer the students the opportunity to study completely unrestricted modules. Nevertheless, a number of approved optional modules are provided at levels two, three and four allowing students to target their programme of study towards any specific subject interests or any aspirations that they may have for employment in particular areas. Students also undertake a group project in year three and an advanced, individual project in the final year, and are able to select from a range of topics so that their project is focused on their area of interest.

A summary of the core/option split for each year of the programme is given below:

	Proportion of core/option modules (%)			
	Year 1	Year 2	Year 3	Year 4
Core	100	83	75	62.5
Options	0	17	25	37.5

In Year 1, students study a combination of modules that provide the fundamentals of signals and engineering mathematics, system modelling and simulation, modelling and control systems, and computing technologies. In addition, practical skills are covered by laboratory and practical skill and computer system design modules which give hands-on experience of test equipment and hardware/software interfacing. Students also participate in a compulsory week-long 'Global Engineering Challenge'. Based on the Engineers without Borders Challenge (a national competition for engineering undergraduates), this gives all first-year engineering students at the University the opportunity to work together in teams to tackle a real-world problem with a global perspective. Formal credits are not awarded for participation in the Challenge Week; however, it is vital for developing the technical competence, understanding of global context and the professional skills that are the hallmark of an excellent engineer.

In Year 2, students focus on control systems in more depth, including modules on discrete systems,

mathematics and data modelling and control systems analysis. Students are also offered optional modules at this stage, allowing them to focus their studies on an area of interest, for example computer problem solving or electrical energy management. Students also build the professional skills they will need as engineers through the introduction of Law and Finance principles. Students take part in a compulsory week-long project called 'Engineering – You're Hired'. Working again with students from other engineering disciplines, this project enables them to put their skills in collaborative working into practice to solve a technical case-study. The project encourages development of entrepreneurial problem solving, accomplished communication, and cultural agility.

In Year 3, students will study more advanced systems and control engineering subjects, including modern control, digital signal processing and rapid control prototyping. Students also have the opportunity to specialise in specific areas of interest via optional modules, including a focus on application areas such as machine learning, robotics or space systems engineering. Students are also exposed to professional skills in project management and human resource management. Students undertake a major group design project, testing and developing their modelling, analysis and design skills on an unfamiliar, extensive problem, whilst also allowing them to develop a range of professional skills including collaborative working, communication skills, team working and delivering a solution to time and budgetary constraints.

In Year 4, students will study more advanced application subjects and have the opportunity for greater specialisation through optional modules, for example in machine intelligence, 3D computer graphics, or computer security and forensics. The final year extended project allows the students to focus in depth on a specific area of interest, selecting a project area from a range of topics. The project also allows the students to enhance their professional skills in project management, organisational and time management skills, report writing and presentational skills.

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

Year 1	Students will consolidate their mathematical, scientific and computing knowledge and be introduced to the fundamentals of systems and control engineering. They will apply these skills to solve simple and standard problems in systems engineering. They will undertake practical experiments and will be able to present, interpret and evaluate data reliably. They will also participate in design exercises requiring conceptual thinking, logical argument and judgement, and allowing the development of communication skills and teamwork. Students will work in cross-faculty teams to tackle a real-world problem with a global perspective, gaining an understanding of global context, technical competence, and developing a range of professional skills.
Year 2	Students will have more extensive knowledge and deeper understanding of system and control engineering and related subjects. They will be able to select and apply established methods of analysis to solve more difficult problems. They will undertake more detailed design work, and develop an enhanced range of practical and IT skills. Students will build their professional skills through an understanding of legal and financial matters, and through the development of skills such as entrepreneurial problem solving, accomplished communication, and cultural agility.
Year 3	Students will develop knowledge of a range of advanced methods of modelling, analysis and control for systems engineering problems, including an understanding of applications. They will develop a range of professional skills, including project management, organisational and time management skills, report writing and presentation skills. Students will undertake a group design project, allowing them to apply theoretical approaches to real-world problems and to develop professional skills in collaborative working and communication.
Year 4	Students will develop knowledge of a range of advanced methods of analysis for systems and control engineering problems, including an understanding of applications. They will develop a range of professional skills, including project management, organisational and time management skills, report writing and presentation skills. Students will develop a high level of creativity, originality and judgement in their project and module studies.

22. Criteria for admission to the programme

Detailed information regarding admission to the programme is available at http://www.sheffield.ac.uk/acse/undergraduates

23. Additional information

The pastoral care of students is very important. All new students are allocated a **Personal Tutor**, who can offer support on a range of matters including advising on module choices, career decisions and in providing references. The Personal Tutor also provides a mechanism for discussing sensitive matters that the student may wish to bring to the attention of the Department in a confidential way.

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

For further information students are directed to the Departmental web pages at http://www.shef.ac.uk/acse. These contain full information on courses and provide access to student handbooks.

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 www.shef.ac.uk/ssid.