

BEng Software Engineering with Integrated Foundation Year Programme Specification

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<https://www.bradford.ac.uk/courses/ug/software-engineering-with-integrated-foundation/>

Academic Year:	2023/24
Degree Awarding Body:	The University of Bradford
Target Degree Awards:	Bachelor of Engineering (BEng) Software Engineering [Framework for Higher Education Qualifications (FHEQ) Level 6];
Interim/exit Awards:	BEng Engineering (Software) [FHEQ Level 6]; Diploma of Higher Education (DipHE) Software Engineering [FHEQ Level 5]; Certificate of Higher Education (CertHE) Software Engineering [FHEQ Level 4] Certificate of Foundation Studies (CertFS) Engineering [Regulated Qualifications Framework (RQF) Level 3]
Programme Admission:	September
Programme Modes of Study:	3-years full time towards BEng (UCAS I300); 4-years full time towards BEng with 'sandwich' placement/study (UCAS I301); 4-years full time towards BEng with integrated foundation year (UCAS I302); 5-years full time towards BEng with foundation and placement (UCAS I303)
Subject Benchmark Statement:	Computing (QAA 2015) and Engineering (QAA 2015)
Programme Accrediting Body:	BCS - The Chartered Institute for IT

Please note: This specification is for the BEng with an integrated foundation year - I302 and I303. Please visit the other course page listed above to access the specification for the I300 and I301 routes.

Please note: This programme specification has been published in advance of the academic year to which it applies. Every effort has been made to ensure that the information is accurate at the time of publication, but changes may occur given the interval between publishing and commencement of teaching. Any change which impacts the terms and conditions of an applicant's offer will be communicated to them. Upon commencement of the programme, students will receive further detail about their course and any minor changes will be discussed and/or communicated at this point.

Minor Modifications Schedule

1. December 2020: Specification reformatted and made accessible
2. July 2021: Learning Outcomes updated
3. August 2021: Changes for 2021 Academic Year
4. July 2022: Changes for 2022 academic year. Removed COS6029-B and included Engineering Council regulations
5. April 2023: Periodic review. Minor modifications for 2023 academic year. More details added in the Introduction, Learning and Teaching Strategy and the Assessment Strategy.

Introduction

Software Engineering is concerned with building computer systems that are error free and totally reliable, such as safety critical systems in aircraft, industrial plants, smart cities and

healthcare. The general principles of engineering are applied to the production of software that meets these stringent requirements. The BEng programme with integrated foundation has been designed to widen participation in Software Engineering and ensure that the next generation of engineers better represent the communities in which they live and work.

The early part of the programme concentrates on the general and theoretical foundations of computer science, problem analysis and solving, and professional skills with a further focus on software engineering topics. It incorporates ideas from many other disciplines, including mathematics, engineering and management and has a close affinity with information and communication technologies as illustrated by the Internet and World Wide Web. The term 'convergence' is often used to describe how these disciplines are coming together, and this is how the software engineering programming builds also on. Later, the emphasis moves to the design, implementation, testing and administration of large software engineering projects.

The BEng Software Engineering with Integrated Foundation Year is offered by the School of Computer Science, AI and Electronics as part of the Faculty of Engineering and Digital Technologies at the University of Bradford, which includes a renowned tradition of undergraduate and postgraduate programmes concerned with the understanding, design, and exploitation of computation and computer technology. The School also places great emphasis on research and research-informed teaching, and there are opportunities for students to join one of our research teams and their projects, and progress on to postgraduate taught programmes or research degrees on completion of their first degree.

Exposure to industry is deeply embedded within this programme in a number of ways. The programme is industry informed with our Industry Advisory Board (IAB), a membership comprised of industry representatives from both regional and national companies, reviewing our provision of the programme and advising on our programme enhancements. The launch of the Computing Enterprise Centre offers to our students the opportunity to develop industry-based projects in the third and final years and provides also industry-sponsored competitive internships. We support industry placements and collaborate with local, national and international organisations offering such job offers through our industry contacts and extended network of successful graduates.

The undergraduate and postgraduate programmes offered by our School are accredited by or aligned to professional bodies including the British Computer Society (BCS), The Chartered Institute for IT and computing professionals such as the Association of Computing Machinery (ACM). The accreditation of our programmes means that successful BEng Software Engineering graduates are exempted from further examinations for professional memberships and ensures that our graduates are not only exposed to industry throughout their course but also are employment ready upon graduation.

Our placement scheme also provides students with the opportunity to work in a company for up to one year in the UK or study abroad as part of their studies. The student societies with links to professional bodies afford further opportunities for students to engage with industry, such as the student Computing Society Pi Soc as the first ever BCS Student Chapter, our ACM Student Chapter and the newest initiative - Association for Women in Computing at University of Bradford (AWC@UoB). The School encourages and offers support to these societies in their participation in industry and research led activities

including programming competitions, data dives and extra-curricular collaborations and visits.

Programme Aims

The aims of the BEng Software Engineering programme are:

- To provide students with a sound grounding in the fundamentals of computer science, software development (programming) and the tools and applications used by software engineers
- To provide the skills needed to enable students to practice as a professional software engineer.

These aims will be achieved by:

- Providing students with a core of fundamental modules, in stages 0, 1 and 2 that are essential to all computer scientists, plus a wide range of options, particularly in the final stage, so that they may choose the particular area in which they are strong or wish to specialise, building on the knowledge and understanding gained earlier.
- Providing the support in the form of lectures, labs and tutorials that will enable students to develop their personal portfolio of skills and knowledge, in line with the School of Computer Science, AI and Electronics' commitment to providing a very high standard of academic delivery and environment, supported by up-to-date computing facilities, hardware devices and software tools.
- Developing discipline and personal transferable skills so that during studies and on graduation students may move directly into responsible positions in industry or commerce (such as placement, graduate schemes respectively) and as business innovators, or may pursue further programmes of study.
- Enabling development of adequate solutions to large-scale real-life problems by adapting and applying fundamental principles and concepts of software engineering, such as languages, tools, techniques, methodologies, standards, quality assurance systems, organisation and management methods.
- Promoting educational opportunities and interest in academic development for ethnic minorities, women, mature and alternatively qualified students, as well as for school-leavers and traditionally qualified students.

Programme Learning Outcomes

To be eligible for progression to Stage 1 of the programme or for the RQF Level 3 exit award of Certificate of Foundation Studies, students will be able to:

- 0.1. Apply knowledge and understanding of mathematics, mechanics, physics, materials and chemistry to an appropriate standard to allow students to engage with an accredited Computer Science programme.
- 0.2. Demonstrate knowledge and skills in the use of computers for word processing, report writing, data processing, power-point presentation, Computer Aided Design;

numerical methods for simple modelling and analysing engineering problems relevant to their chosen specialism; selection and application of principles and data collection & manipulation methods to support problem solving; undertake and report on an investigation.

- 0.3. Demonstrate knowledge and skills in data management and presentation, IT and communication skills, systematic problem solving, lifelong learning, scientific method, teamwork, and personal management.

Additionally, to be eligible for the FHEQ Level 4 award of Certificate of Higher Education, students will be able to:

1. Describe the history and development of computer science and outline important concepts and topics within the field.
2. Outline the professional, ethical, security, industrial and research dimensions of the discipline of computer science.
3. Demonstrate knowledge of fundamental concepts of computer science, and the environment in which they operate; basics of software construction and the tools required to support it, develop skills in constructing complex software solutions.
4. State and explain relevant models, principles and practices applicable to the study of computers, computer architecture and systems.
5. Demonstrate knowledge of a range of underlying theories, logical and mathematical foundations relevant to computer science.
6. Work effectively as individuals and in groups.
7. Collect, manage and present information, ideas and concepts, interpret data using suitable techniques, and communicate efficiently with a range of audiences.

Additionally, to be eligible for the FHEQ Level 5 award of Diploma of Higher Education, students will be able to:

8. Apply methods, methodology, knowledge, skills and standards to build complex software systems through teamwork.
9. Apply knowledge of investigative and research principles to demonstrate an understanding of how to develop computing designs, databases, and processes.
10. Develop computational thinking for problem solving, algorithm design and assessing efficiency of different implementations.
11. Demonstrate the use of practical computer science skills in designing, developing and monitoring communication networks.
12. Demonstrate fundamental understanding of various applications of AI techniques in solving computational problems.

13. Apply knowledge of the fundamentals of security management and the system tools required to manage vulnerabilities.
14. Communicate effectively with industry and other computing professionals and demonstrate personal and technical skills.

Additionally, to be eligible for the FHEQ Level 6 Degree award of Bachelor of Engineering, students will be able to:

15. Demonstrate a systematic understanding of key aspects of their field of study, including acquisition of coherent and detailed knowledge informed by aspects of Software Engineering.
16. Deploy accurately established techniques of analysis and enquiry within Software Engineering.
17. Show conceptual understanding that enables students to devise and sustain arguments, and/or to solve problems, using ideas and techniques, and to describe and comment upon particular aspects of current research, or equivalent scholarship, or practice in Software Engineering.
18. Develop an ability to make critical use of relevant literature to discuss aspects of current research in the discipline, to make use of primary sources, to manage and communicate their own learning, and to recognise the uncertainty, ambiguity and limits of knowledge.
19. Develop a systematic understanding of the fundamental concepts and theories of software engineering including detailed knowledge of hardware, computer architecture, information and communication technologies.
20. Build complex software systems using state of the art software design and development methods; apply various testing techniques to validate the requirements of a wide range of software systems.
21. Use software technologies to design and develop large-scale database applications.
22. Apply concepts and principles in key computing subjects, including data and information security and forensics, information systems, large scale databases, communication networks, and parallel and distributed systems.
23. Demonstrate professional interest and expertise for a variety of careers such as software engineer, software designer and software architect, software developer, system administrator, IT project manager, IT consultant or computing researcher that match both learners and employers expectations.
24. Show a firm grasp of the mathematical foundations of computing and how they underpin the formal specification and design of large commercial or research applications.
25. Analyse problems and develop solutions using leading edge ideas and techniques
26. Have competence in the use of major software application packages.

27. Exercise initiative in information management, interpretation and presentation of Software Engineering tools, products and solutions.

Curriculum

The BEng Software Engineering with Integrated Foundation Year curriculum is organised into modular units, studied across the "Academic Year" of September to May or discretely in a single Semester. Students study 120 credits in total in each stage/year.

The Integrated Foundation Year introduces students to the principles of engineering as a whole, introducing foundational concepts, frameworks and techniques common to other Engineering professions before contextualising them for Software Engineering.

The year features practical elements where students spend time in laboratories to conduct experiments on engineering applications. Students will be able to develop awareness of the breadth of opportunities and challenges posed by engineering and the exciting possibilities for their career development.

Table i: Stage 0 Modules (RQF Level 3/CertFS)

Study Period	Code	Title	Credit	Level	Type
Semester 1	ENM3001-B	Foundation Mathematics 1	20	RQF 3	Core
Semester 2	ENM3002-B	Foundation Mathematics 2	20	RQF 3	Core
Academic Year	MAE3001-B	Foundation Mechanics	20	RQF 3	Core
Academic Year	MAE3002-B	Foundation Physics	20	RQF 3	Core
Academic Year	MAE3003-B	Fundamentals of Materials	20	RQF 3	Core
Academic Year	ENB3001-B	Information and Communication Technology	20	RQF 3	Core

At the end of Stage 0 (RQF level 3), students will be eligible to exit with the award of Certificate of Foundation Studies if they have successfully completed 120 RQF credits and achieved the award learning outcomes 0.1-0.3. The CertFS award is generally only awarded to students leaving the University. THIS AWARD DOES NOT CONFER ELIGIBILITY TO REGISTER WITH BCS.

Stage 1 Modules (FHEQ Level 4/CertHE)

Study Period	Code	Title	Credit	Level	Type
Semester 1	COS4016-B	Fundamentals of Programming	20	FHEQ 4	Core
Semester 1	COS4014-B	Mathematics for Computing	20	FHEQ 4	Core
Semester 1	COS4015-B	Technical and Professional Skills	20	FHEQ 4	Core
Semester 2	COS4001-B	Computer Architecture and Systems Software	20	FHEQ 4	Core
Semester 2	COS4018-B	Internet Technologies	20	FHEQ 4	Core
Semester 2	COS4017-B	Software Design and Development	20	FHEQ 4	Core

At the end of stage 1 (FHEQ level 4), students will be eligible to exit with the award of Certificate of Higher Education if they have successfully completed at least 120 FHEQ credits and achieved the award learning outcomes 0-7. THE CERT.HE AWARD DOES NOT CONFER ELIGIBILITY TO REGISTER WITH BCS.

Stage 2 Modules (FHEQ Level 5/DipHE)

Study Period	Code	Title	Credit	Level	Type
Semester 1	COS5028-B	Artificial Intelligence	20	FHEQ 4	Core
Semester 1	COS5021-B	Data Structures and Algorithms	20	FHEQ 4	Core
Semester 1	COS5020-B	Database Systems	20	FHEQ 4	Core
Semester 2	COS5025-B	Computer Communications and Networks	20	FHEQ 4	Core
Semester 2	COS5019-B	Enterprise-Pro	20	FHEQ 4	Core
Semester 2	COS5017-B	System Security Management	20	FHEQ 4	Core

At the end of stage 2 (FHEQ level 5), students will be eligible to exit with the award of Diploma of Higher Education if they have successfully completed at least 240 FHEQ credits and achieved the award learning outcomes 0-14. THE DIP.HE AWARD DOES NOT CONFER ELIGIBILITY TO REGISTER WITH BCS.

At Stage 3 (level 6), students take 80 core credits including the Final Year Project and select 2 optional modules from a choice of 5.

Stage 3 Modules (FHEQ Level 6/BEng)

Period	Code	Title	Credit	Level	Type
Academic Year	COS6006-D	Final Year Project	40	FHEQ 6	Core
Semester 1	COS6009-B	Large Scale Data Driven Applications	20	FHEQ 6	Core
Semester 2	COS6028-B	Software Systems Design and Testing	20	FHEQ 6	Core
Semester 1	COS7025-B	Mobile Application Development	20	FHEQ 7	Option
Semester 1	COS6021-B	Numerical Methods and Computer Graphics	20	FHEQ 6	Option
Semester 2	COS6012-B	Concurrent and Distributed Systems	20	FHEQ 6	Option
Semester 2	COS6026-B	Machine Learning	20	FHEQ 6	Option
Semester 2	COS6025-B	Principles of Security Technologies	20	FHEQ 6	Option

At the end of stage 3 (FHEQ level 6), students will be eligible to exit with the Degree award of Bachelor titled Engineering (Software) if they have successfully completed 360 FHEQ credits but have not met the programme-specific requirements for an accredited award. BENG ENGINEERING (SOFTWARE) DOES NOT CONFER ELIGIBILITY TO REGISTER WITH BCS.

Students will be eligible to for the Degree award of Bachelor titled Software Engineering if they have successfully completed 360 FHEQ credits, achieved learning outcomes 0-27 and met the programme-specific accredited award regulations.

ONLY BENG SOFTWARE ENGINEERING CONFERS ELIGIBILITY TO REGISTER WITH BCS.

Please note: The curriculum may change, subject to the University's programme approval, monitoring and review procedures.

Placement and/or Study Abroad

This programme provides the option for students to undertake a work placement or period of study abroad between the 2nd and 3rd stages of the BEng. Students wishing to take this option will be encouraged to register for the placement year programme. All Faculty of Engineering students are encouraged to apply for Industrial Placements (Year in industry).

Timetabled Pre-Placement lectures and Timetabled 'drop-in' sessions will be scheduled to support students throughout the pre-placement process. All placement opportunities received are made available to students on the placement route via the VLE.

Students can also access various support services organised by Career and Employability Services including one-to-one appointments, Employability Workshop/Webinar Programme, Careers Fairs and jobs/placement opportunities. Students are encouraged to take the opportunity to find their own placement.

- On successful completion of the placement (ENG5002-Z) students will be eligible for the additional award of University Diploma Industrial Studies.

Students can alternatively go abroad for a year after their second year.

- On successful completion of study abroad experience (ENG5004-Z) students will be eligible for the additional award of University Diploma Industrial Studies (International).

For further information about study abroad opportunities, including shorter opportunities available for all students, please refer to: <https://www.bradford.ac.uk/study/abroad/>

Learning and Teaching Strategy

At stage 0 (Foundation level), cognitive and personal skills are developed in more open-ended problem solving and design exercises, often tackled by working in small groups supported by members of academic, technical, and library staff. Project work is used to bring various aspects of the programme together. Typically, each module will involve students in 72 hours of scheduled contact except Mathematics for which students will have 96 hours of scheduled contact for each module. An expected weekly attendance commitment will be around 21 hours.

Our Learning and Teaching Strategy is to provide a nurturing and supportive environment that enables students to become an independent learners and problem solvers. Students will be supported via various approaches including for e.g. learning in small groups and in practical laboratory sessions where discussions and formative feedbacks are embedded,

having the support of lecturers, demonstrators and project supervisor, who all provide academic support and guidance. Students will also have their own personal academic tutor (PAT) who provides academic and pastoral care throughout the programme of study. Students will also have the opportunity to be part of the University of Bradford Computing Society for students, PiSoc, as well as the Peer Assisted Learning (PAL) scheme, where students are able to meet with other fellow Computer Science students at different stages of their study. The programme is designed to develop your knowledge and skills in ways to allow gradual transition from one stage to the next.

Students will experience a wide range of teaching and learning environments and a consistent balance between direct academic delivery, and individual and group study. Each 20-credit module on the programme requires students to commit 200 hours of study. Many of these hours will be formally timetabled - lectures, laboratories, seminars and tutorials - and others will involve students carrying out private study or group work. The balance between these forms of study changes as students pass through the three years of the programme. Concepts, principles and theories are generally explored in formal lectures, practiced in associated tutorials and seminars, and demonstrated and experimented in laboratory classes.

- We make use of case studies so that students can apply their theoretical understanding to real-world issues. In this way, abstract concepts are brought to life through practical activities.
- Practical skills are developed in laboratory sessions.
- The Enterprise-Pro group project module develops an appreciation of how to manage group dynamics whilst working on a substantial computing and software engineering exercise.
- Team Based Learning (TBL) strategies are integrated within a number of the modules. We also endeavour to use team teaching methods where lecturing staff are able to contribute their specialised research and knowledge into the curriculum.
- BEng students undertake a major individual project in their final year, drawing together the knowledge and experience gained throughout the programme. The project provides the opportunity for students to demonstrate the ability to solve problems using current ideas and current, cutting-edge techniques that are at the forefront of computing and applied multidisciplinary disciplines.

There are many contact hours (time spent with academic tutors) in all stages of the programme; in the final year students will also be expected to manage their plan for the individual project, under the general guidance of their academic tutors.

In addition, the learning and teaching on the programme are informed by industry and by staff undertaking KTP projects, national and EU funded research projects and consultancy work that embed new knowledge and concepts into our teaching materials and curriculum planning; and inviting industrial speakers. Throughout the academic year industry speakers and researchers are also invited to give talks and lectures that inform and inspire our students about current and future developments within their disciplines.

Cutting edge projects initiated by industry are also embedded within a number of the modules, such as Technical and Professional Skills (level 4), Enterprise-Pro (level 5) and

Final Year Project (level 6), through our Computing Enterprise Centre, allowing students to work on topics that are highly relevant to their future careers throughout the course.

Students will also have the opportunity to interact with our Independent Computing Industry Advisory Board members and a wider audience of industry contacts during the Final Year Project Showcase, which allows them to demonstrate their work and to receive feedback and ideas from professionals within the discipline.

We use CANVAS to share course materials and reading lists, communicate with students, track student participation, facilitate discussions, support formative and summative assessments and provide feedback. Students can use Canvas independently to revise materials, ask questions and interact with lecturers and other students using discussions, practise and assess their understanding using quizzes, or for finding resources for further reading.

We embed technologies to deliver key concepts in an interactive environment that strongly links theory with practical skills. For example: in programming lectures, a remote desktop application allows lecturers to demonstrate coding in an environment identical to that in our cutting-edge labs; our Enterprise-Pro module (level 5) requires and supports students to develop their projects using an industry standard tool for collaborative team-based software development. This allows students to develop industry standard skills based on real working practice.

All of our staff have achieved, or are working towards, Fellowship of the Higher Education Academy (FHEA). As part of our commitment to Excellence in Learning and Teaching, we conduct research into innovative and effective teaching methods. For example, assessment for our Final Year Project module was enhanced by incorporating regular formative and summative feedback opportunities to enhance the final outcomes, based on a research project conducted by staff within the School that culminated in a journal publication.

Our curriculum development is informed by the research conducted by academic members of staff within the School, exposing students to the cutting-edge developments within the related fields of expertise. Knowledge and experience from Industrial partners are also integrated within the programme through both our Industry Advisory Board and research projects through case studies, lab-based activities and invited talks, ensuring that research findings are at the heart of our curriculum.

Equality, diversity and inclusion are embedded in our programme's learning and teaching activities. We celebrate differences and ensure that everyone has equal opportunities to achieve their desired outcomes. Students are also instilled with the understanding of ethical and professional issues within the context of computer science and IT and the responsibilities around these issues. Students will be encouraged to explore a diverse range of digital technologies and theories and engage constructively with businesses and communities to enrich their understanding of the impact of Software Engineering and embrace the values of equality, diversity and inclusion in their development of Software Engineering solutions. This approach will equip students with the wider perspective of the relevance of the programme for the improvement of businesses and society.

Assessment Strategy

Methods of assessment are varied, and progress will be assessed using a mix of formal examinations, presentations and seminar papers, reports, laboratory tests, essays, coursework assignments, and projects. The appropriate method is chosen so that students may demonstrate the particular learning outcomes of each module.

Assessment Regulations

This Programme conforms to the standard University Regulations, available at the following link: <https://www.bradford.ac.uk/regulations/>

However, the following exceptions to the Assessment Regulations apply:

- Compensation is only permitted in a maximum of 20 credits across the whole programme with a mark no lower than 30%.

If the above requirement is not met, but the University's undergraduate regulations are complied with, then a non-accredited BEng will be awarded BEng Engineering (Software)

Admission Requirements

The University welcomes applications from all potential students and most important in the decision to offer a place is our assessment of a candidate's potential to benefit from their studies and of their ability to succeed on this particular programme. Consideration of applications will be based on a combination of formal academic qualifications and other relevant experience.

The minimum entry requirements for the programme are as follows:

A typical offer to someone seeking entry through the UCAS scheme would be 72 UCAS points, a minimum of GCSE Maths grade D/grade 3 and GCSE English grade D/grade 3 (equivalents accepted) although having post GCSE Maths would be an advantage.

Access and Recognition of Prior Learning

Applications are welcome from students with non-traditional qualifications, and/or significant personal/professional experience. For such applicants, evidence of their interests and any work experience would be required and this would likely take the form of a portfolio of work and/or an interview with the programme.

The University of Bradford has always welcomed applications from disabled students. To discuss adjustments or to find out more about support and access, you may wish to contact Disability Services before you apply online: www.bradford.ac.uk/disability/before

Applications are particularly welcomed from adult learners (those aged 21+ at the start of the programme), armed forces families, carers and care leavers, estranged or orphaned learners, refugees and asylum seekers, and Romani or Traveller families. To find out more about the University of Bradford Progression Scheme, visit the webpage: <https://www.bradford.ac.uk/applicants/progression-scheme/>

If applicants have prior certificated learning or professional experience which may be equivalent to parts of this programme, the University has procedures to evaluate and recognise this learning in order to provide applicants with exemptions from specified

modules or parts of the programme. For more details on RPL, visit the webpage:
<https://www.bradford.ac.uk/teaching-quality/prior-learning/>

Please note: This information is relevant to the contemporary recruitment cycle and therefore may be different now to when this document was originally published. The current UCAS tariff for the programmes, as well as accepted equivalent qualifications, is published online at the course pages:

<https://www.bradford.ac.uk/courses/ug/software-engineering-beng/>

<https://www.bradford.ac.uk/courses/ug/software-engineering-with-integrated-foundation/>
