UNIVERSITY of BRADFORD
Faculty of Engineering and Informatics

MSc Digital Civil Engineering Programme Specification

https://www.bradford.ac.uk/courses/pg/digital-civil-engineering/

Academic Year: 2021/22
Degree Awarding Body: The University of Bradford
Target award at Framework for Higher Education Qualifications (FHEQ) Level 7:
Master's Degree of Science in Digital Civil Engineering
Interim and exit awards at FHEQ Level 7:
Postgraduate Diploma; Postgraduate Certificate
Programme Admissions: September
Programme duration: 1 year full time; 2 years part time (flexibly up to 5 years)
QAA Subject Benchmark: Engineering
Date last approved by Faculty Board: July 2021

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. September 2021: New programme

Introduction

Civil Engineering is a highly important and ever-evolving profession, involving the design, construction, maintenance, operation and decommissioning of crucial infrastructure facilities, upon which modern life depends. Civil engineering aims to improve and maintain the built and natural environment with the best use of resources to enhance the quality of life for present and future generations.

This mission is closely related to the United Nations Sustainable Development Goals 9 and 12 for 2030:

9. **Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation.**

12. **Ensure sustainable consumption and production patterns.**

In recent years the nature of civil engineering work has changed rapidly, with an increased interest in areas such as smart buildings and motorways, building information modelling and the use of sensors. To enhance the competitiveness of the design and construction of infrastructure to meet 21st century challenges, modern engineers require strong digital skills in addition to technical engineering knowledge.

Most undergraduate and postgraduate degree programmes in the UK focus on developing the students' technical and subject-specific knowledge, with limited coverage of digital technology as there is limited 'room' within these curricula to cover the digital aspects. Those entering the civil engineering field are increasingly required to continue their education after bachelor's graduation and are required to increase their knowledge base to remain competitive. The MSc in Digital Civil Engineering has been devised to address these specific needs.

Programme overview

The MSc Digital Civil Engineering programme is delivered jointly by the Department of Civil and Structural Engineering and the Department of Computer Science, where an emphasis is placed on providing a supportive environment that will provide students with the knowledge and learning skills to tackle the future challenges in industry. Postgraduates will be able to move directly into responsible roles in employment with a minimal need for additional training.

This will be achieved by:

- Providing a supportive, structured environment in which students are encouraged to develop independent learning skills
- Developing subject knowledge and understanding, discipline skills and personal transferable skills, to enable them to pursue programmes of advanced study, or to move directly into responsible employment

This programme is ideal for those with a civil engineering degree/background, who are interested in pursuing a career in digital applications. It will equip you with a solid understanding of the applied computational tools in civil engineering, which can be applied to many real-life engineering problems. You will study subjects such as Modelling and Optimisation, Statistical Applications of Industrial Big Data, Building Information Modelling, Software Development, Big Data Visualisation, Advanced Geotechnics, Water and Wastewater Treatment, Industrial Big Data Analysis and Mining and Transportation Engineering. After graduating, you will have the skills and knowledge to operate in an increasingly digital world, to design, construct and manage complex projects.

The University of Bradford

The University has four key values in its emerging strategy for 2020-25: excellence, inclusion, innovation and trust: Our aim is to drive sustainable social and economic development through outstanding teaching, research and innovation. Our vision is a world of inclusion and equality of opportunity where people want to, and can, make a difference. The Faculty of Engineering and Informatics strongly believes that each programme subscribes to these four objectives through the three key streams of the University vision:

- The creation of knowledge through fundamental and applied research.
- The dissemination of knowledge by teaching students from all backgrounds.
- The application of knowledge for the prosperity and wellbeing of people.

Lecturers at Bradford are active researchers in their fields of expertise, developing new knowledge, contributing to peer-reviewed journals and books. This research permeates their teaching practice giving students access to world leading professionals, equipment

and ideas within the University's academic themes of Innovative Engineering, Advanced Healthcare, and Sustainable Societies. Each year students engage in enquiry-based projects allowing learning through research. This MSc programme will include a research project with an emphasis on application, experiential learning and real-world engagement. This will make a major contribution to the student's skill set, which will enhance their employability.

We recognise that society benefits from the talents of all, and that the development of creative, collaborative engineers, skilled in communication and teamwork is vital. Diverse engineering teams are known to be more innovative. We help students to contribute to and learn from the varied perspectives of their tutors and peers. We want to equip our graduates with the knowledge and skills to respond to the many different and ever-changing needs of our societies and businesses. The Faculty welcomes and celebrates the diverse cultural and national backgrounds of our students and staff. We are committed to an educational experience that is inclusive, one where gender and ethnicity are central elements in developing engineering solutions that address the needs of a diverse society. The University currently holds Bronze Athena Swan accreditation from AdvanceHE.

Is this the right course for me?

It is worth noting that the University of Bradford also offers a taught MSc in Advanced Civil and Structural Engineering, which is focused on gaining a deep technical understanding of a range of traditional civil engineering topics, such as geotechnics, structures, wastewater treatment. That programme may be more suited to graduates from other engineering fields looking to move into civil engineering. On the other hand, this MSc in Digital Civil Engineering places more of an emphasis on enhancing the digital skills of existing civil engineers in order to tackle 21st century challenges in this field. Students will develop skills such as optimisation, data-handling and programming, in addition to gaining an appreciation of digital applications of civil engineering.

Programme Aims

The programme is intended to:

- Provide students with the advanced theoretical knowledge, concepts and skills necessary for original thought and problem analysis related to digital civil engineering.
- Equip students with deepened academic and technical skills necessary to integrate data driven approaches into engineering knowledge and understanding to solve a range of complex engineering problems.
- Enable students to carry out independently, but under supervision, a specific research project in digital civil engineering.

Programme Learning Outcomes

To be eligible for the FHEQ Level 7 award of Postgraduate Certificate, students will be able to:

1. Demonstrate a deep appreciation of digital aspects of Civil Engineering, and how tools and methodologies at the discipline forefront can be applied to solve engineering problems.

2. Select and apply appropriate advanced modelling and analysis methods to critically evaluate complex problems in engineering, generate (optimised) solutions, and assess their limitations, robustness, and effects of changes in design parameters.
3. Demonstrate a comprehensive understanding of theory, platforms and processes associated with Building Information Modelling, and how it can be used to improve the efficiency of a project throughout its lifecycle.
4. Evidence advanced skills for understanding and analysing large volumes of data in civil engineering projects.
5. Work effectively in a team in order to meet shared objectives.
6. Integrate engineering knowledge and insight to investigate new and emerging technologies, applying professional judgements to balance risks, cost, benefits, safety, reliability and environmental impact.

Additionally, to be eligible for the FHEQ Level 7 award of Postgraduate Diploma, students will be able to:

7. Evidence self-direction, independent learning, and originality of thought to generate innovative designs for products, systems, components or processes to fulfil new needs.
8. Plan self-learning to improve performance as a foundation for lifelong learning/CPD, and exercise initiative and personal responsibility in professional practice, which may be as a team member or leader, evidence good negotiation, written and oral communication skills
9. Demonstrate transferable skills to make appropriate decisions when working with incomplete data, or in complex or unpredictable situations.

Additionally, to be eligible for the FHEQ Level 7 Degree award of Master of Science, students will be able to:

10. Plan, implement, monitor and adjust on an on-going basis, a self-directed individual research programme of work, evidencing collection and critical analysis of articles, journals, studies and research data, use or adaptation of appropriate analysis tools to tackle unfamiliar problems (e.g., those with uncertain or incomplete data or specification), innovation, and application of relevant skills, reflection, and research methodologies in the production of an advanced technical report.

Curriculum

Students undertaking the programme on a full-time basis will complete 60 credits in each semester. For Semesters 1 and 2, they will take three 20-credit modules. In Semester 3, they will complete the MSc project, worth 60 credits.

The MSc Project is a major research project, carried out by individual students on a topic of their choice, supervised by a member of academic staff. This draws on skills such as self-direction, planning, critical analysis of literature, adaptation of existing tools and reflection. The taught modules in Semesters 1 and 2 include a broad range of learning and

assessment activities, that contribute to the development of these skills that are necessary for the project.

The curriculum may change, subject to the University's programme approval, monitoring and review processes.

Modules

FHEQ Level	Module Title	Module Type	Credits	Study Period	Module Code
7	Statistical Applications of Industrial Big Data	Core	20	Semester 1	COS7049-B
7	Modelling and Optimisation	Core	20	Semester 1	ENM7005-B
7	Software Development	Option	20	Semester 1	COS7009-B
7	Big Data Visualisation	Option	20	Semester 1	COS7046-B
7	Advanced Geotechnics	Option	20	Semester 1	CSE7009-B
7	Industrial Big Data Analysis and Mining	Core	20	Semester 2	COS7050-B
7	Building Information Modelling	Core	20	Semester 2	CSE7018-B
7	Water and Wastewater Treatment	Option	20	Semester 2	CSE7013-B
7	Transportation Studies	Option	20	Semester 2	CSE7019-B
7	MSc Project	Core	60	Semester 3	ENG7002-E

Please note:

- Pre-requisite knowledge from Statistical Applications of Industrial Big Data is required in order to take Industrial Big Data Analysis and Mining.
- Modelling and Optimisation and modules related to big data will involve computer programming, but this will be taught during the modules and prior knowledge will not be required. Additional support and taught sessions will be provided as needed for students without a programming/computer science background. Those who wish to develop their programming skills further, however, may benefit from selecting Software Development in Semester 1.
- Big Data Visualisation may suit those who wish to extend their data-handling techniques beyond those used in Statistical Applications of Industrial Big Data and Industrial Big Data Analysis and Mining.
- Optional modules Advanced Geotechnics, Transportation Studies and Water and Wastewater Treatment are more focussed on traditional technical civil engineering topics, including digital applications in these areas.
- Students who completed their undergraduate degree in the University of Bradford and selected Transportation Studies during Stage 3 may not select the Transportation Studies module.

Eligibility for Awards

Students will be eligible to exit with the award of Postgraduate Certificate if they have successfully completed 60 credits and achieved the award learning outcomes.

Students will be eligible to exit with the award of Postgraduate Diploma if they have successfully completed at least 120 credits and achieved the award learning outcomes.

Students will be eligible for the award of Degree of Master if they have successfully completed at least 180 credits and achieved the award learning outcomes.

Flexible Student Journey Options for Part-time Study

Part-time study for this programme has been devised specially to fit with the living and working arrangements of those who enrol on this route. Part-time students are expected to complete this programme over a period of 2-5 years and can arrange a flexible mode of study that suits them.

Students undertaking the programme on a part-time basis may select as many modules as they wish, up to 40 credits, in each Semester, until they complete 180 credits. They may take the MSc Project module during Semester 3 of any of these years, once they have completed 60 credits of taught modules. Timetabling will be arranged in such a way that those who are released from work on one day per week can complete one module per semester (3 years for programme).

The following table presents some examples of the structure for a 2-year part-time MSc student:

Year	Semester	Example Student 1	Example Student 2	Example Student 3
Year 1	Semester 1	20 credits	40 credits	20 credits
	Semester 2	40 credits	20 credits	20 credits
	Semester 3	-	60 credits	-
Year 2	Semester 1	40 credits	20 credits	40 credits
	Semester 2	20 credits	40 credits	40 credits
	Semester 3	60 credits	-	60 credits

The following table presents some examples of the structure for a 3-year part-time MSc student:

Year	Semester	Example Student 1	Example Student 2	Example Student 3
Year 1	Semester 1	20 credits	40 credits	20 credits
	Semester 2	20 credits	-	20 credits
	Semester 3	-	-	-
Year 2	Semester 1	20 credits	20 credits	-
	Semester 2	20 credits	20 credits	40 credits
	Semester 3	60 credits	-	60 credits
Year 3	Semester 1	20 credits	-	40 credits
	Semester 2	20 credits	40 credits	-
	Semester 3	-	60 credits	-

Please note: These tables are provided for illustrative purposes and are not an exhaustive list of route options.

Learning and Teaching Strategy

Our strategy begins with the end in mind. We want students to become great digital civil engineers who are able to provide creative, efficient solutions. This should mean that by the end of their study with us they can move seamlessly into the world of work, academic research or become an entrepreneur.

This MSc programme at the University of Bradford is designed to provide education relating to Digital Civil Engineering to produce 'fit-for-purpose' graduates, equipped with the skills necessary to operate in an increasingly digitalised civil engineering industry, and to enable these graduates to meet their career aspirations. Embedding the strategic aims of the Universities Learning, Teaching and Student Experience Strategy (LTSES), the programme is designed to achieve a balanced between subject knowledge and transferable skills.

The student journey has been considered at programme-level and the core modules will provide students with skills and knowledge that are deemed to be fundamental to this discipline, whereas optional modules are also included to recruit interest and offer students more choices and to meet their interests. In addition to the modules, academic skills workshops will be organised during the year to provide further support in self-regulation, persistence and the development of essential skills such as digital literacy. In future, this programme will seek accreditation from the Joint Board of Moderators (JBM) as meeting the requirements for Further Learning for a Chartered Engineer, and as an MSc for holders of a BEng degree that partially meets the educational base requirement for Chartered Engineering status.

The teaching and learning strategy takes into consideration the learning outcomes, the nature of the subject and the student intake, and the need for students to take greater responsibility for their own learning as they progress through the Programme. The teaching and learning methods have been selected to engage students in developing their fundamental knowledge and understanding through formal learning opportunities such as lectures, seminars and tutorials and informal and social learning through team-working in projects and competitions. Multiple means of engagement will be used to keep students purposeful and motivated, with a sustained effort throughout their learning journey. Team-working will be used to foster collaborations and a sense of community between the students. Opportunities will also be provided for self-evaluation and reflection, so that students can learn to self-regulate.

Study with us will include formal lectures (including those from the Visiting Professors and guest speakers from industry), but these will always be interactive and two way. We want to develop students' understanding of the vast array of opportunities open to today's professional engineer and therefore we look to incorporate aspects of real-world engineering problems and solutions where possible. To this end we make use of case studies, practical demonstrations, and also provide an array of resources and background information from which students can deepen their comprehension. Most teaching activities will take place face-to-face but, if necessary, the teaching and learning methods can be adapted to include a combination of online lectures/tutorials and seminars (synchronous or asynchronous), and workshop events etc. Several opportunities will be provided for students to engage with industrial experts, through activities such as visiting guest lectures and organised site visits. The Department of Civil and Structural Engineering also liaises closely with professional institutions such as the IStructE and ICE, providing many networking and development opportunities for our students.

To support accessibility, clarity and comprehension, all teaching material is provided online in advance of the teaching sessions, allowing students to customise the display of information and their learning experience as a whole. Throughout the programme, lots of

opportunities are provided for students to design their own solutions and to express their own ideas, choosing from a variety of tools and methodologies. An emphasis is also placed on the importance of planning and goal setting, allowing students to forge a learning pathway that is suitable for their needs, while respecting the requirements of programme, and the needs of others, when working within a team.

The University recognises the importance of providing pastoral support, taking into consideration all aspects of our students' journeys and development. All students are allocated a personal academic tutor, with whom they meet regularly to discuss and receive guidance on their learning and development. The University also operates a wide range of support services covering areas such as disability, counselling, faith advisors and careers.

The University of Bradford is well known for attracting students from a wide variety of backgrounds, experiences and countries. The University of Bradford encourages and supports women in engineering, celebrating events such as International Women in Engineering Day. Some of the staff in the Faculty of Engineering and Informatics are also STEM ambassadors, who actively promote science and engineering subjects to wider audiences. Female staff and students are an integral part to the University of Bradford's Faculty of Engineering and Informatics. The University has held Bronze Athena Swan accreditation on an institutional level since 2015, demonstrating our commitment to striving for gender equality. The University of Bradford's modus operandi, Making Knowledge Work, is embedded in the philosophy of this programme. The Civil Engineering Society at the University of Bradford provides a social as well as academic platform for all students and staff to socialise, interact, share experiences and run extra-curricular activities.

Assessment Strategy

In the same way that our teaching and learning strategy is designed to prepare students for the world of work, academic research or entrepreneurship, our assessment methods incorporate a wide range of different methods designed to meet the needs of industry and the accrediting bodies, in addition to preparing students for a potential academic research career. Assessment is a key part of the learning process of our students. It is only through challenging themselves to express what they have learned or put it to practical use, that they can complete the learning journey and assess for themselves if they have understood what they have been taught and whether they are able to apply and use those skills and knowledge.

There are two forms of assessment: formative and summative. Formative assessment provides an opportunity for our staff to give students feedback during their learning. This feedback is designed to help and guide their learning. All of the modules will have some formative assessment, and this may be in various forms, including discussions or questioning from their supervisor, tests, practical activities, et cetera. These formative activities are crucial if students are to make best use of their learning experience and they are designed to prepare students for their summative assessment.

Summative assessment is how we grade the work on a module and the details of this assessment will be available from the beginning of the module so that students understand how their grade will be determined. Summative assessment will mostly be by a

combination of formal written examinations, individual/group coursework and presentations, depending on the module.

These methods of assessment not only assess subject-specific knowledge and skills, but also a suite of transferable skills that will provide students with a competitive edge when they graduate.

Assessment Regulations

This Programme conforms to the standard University Postgraduate Assessment Regulations which are available at the link: https://www.bradford.ac.uk/regulations/

Admission Requirements

We take into consideration a number of factors when assessing your application. It's not just about your grades; we take the time to understand your personal circumstances and make decisions based on your potential to thrive at university and beyond.

In addition to satisfying the general admissions requirements of the University of Bradford, the typical applicant profile for this programme is to have at least a Second-class Bachelor's Degree with Honours in Civil Engineering, or its equivalent, or in a closely related discipline.

International students are welcome to apply and should check their country page website for details of equivalent qualifications: https://www.bradford.ac.uk/international/country/

For all students whose first language is not English, the standard postgraduate English language requirements for the University apply and these are listed at: https://www.bradford.ac.uk/international/entry-requirements/

Access and Recognition of Prior Learning

Applications are welcome from students with non-traditional qualifications, and/or significant personal/professional experience. Candidates who do not fulfil the normal entry requirements but have extensive industrial experience related to Civil Engineering are considered on an individual basis.

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 the Disability Service before you apply at 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.

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: www.bradford.ac.uk/teaching-quality/prior-learning/