UNIVERSITY of BRADFORD

Faculty of Engineering and Informatics

Programme Specification

Programme Title: MSc Internet of Things

Academic Year:	2018/19
Degree Awarding Body:	University of Bradford
Partner(s), delivery organisation or support provider (if appropriate):	
Final and interim award(s):	[Framework for Higher Education Qualifications (FHEQ) level 7] MSc Postgraduate Diploma Postgraduate Certificate
Programme accredited by (if appropriate):	
Programme duration:	1 Year Full-time, 2 Years part-time
QAA Subject benchmark statement(s):	Master's degrees in Computing Subject Benchmark Statement(http://www.qaa.ac.uk/en/Publications/Documents/SBS-Masters-degree-computing.pdf)
Date of Senate Approval:	25 April 2018
Date last confirmed and/or minor modification approved by Faculty Board	

Introduction

It is envisaged that by 2020, over 50 billion devices around the globe will be connected to the Internet.75% of companies are already exploring how to adopt Internet of Things (IoT) for their business operations. IoT will bring about efficiency benefits of £72.5bn, innovation benefits of £4.5bn and business creation benefits of £4.3bn over the next five years in the UK. IoT is considered the base of the second digital revolution. IoT technologies allow billions of everyday objects to communicate with each other over the Internet, with enormous potential to change many aspects of our lives. Smart Cities, Industrial Internet of Things (IIoT), Self-Driving cars, Smart Grids, Smart Homes and Buildings, Smart Infrastructure, Smart Agriculture, Smart Health, Smart Mobility are some of the application areas driving the phenomenal growth of IoT to a mainstream technology.

"A lack of IoT skills and knowledge among employees and management is viewed by the businesses as the biggest obstacle to using the IoT more extensively"[1]. There

[1] The Internet of Things Business Index – A quiet revolution gathers pace. A report from the

is a shortage of professionally qualified IoT specialists.

This postgraduate programme aims to deliver that precise need, preparing graduates with cutting edge knowledge and expertise in the modern world of IoT and smart cyber physical systems. It will give graduates a unique advantage in the job market with expertise in:

- development of Smart Cyber Physical Systems
- designing efficient communication and data management techniques
- state-of-the-art data science techniques and Big Data processing tools for handling large, complex and real-time data
- handling unique security and privacy challenges in IoT systems
- understanding international issues related to the development of smart cities and other smart systems
- developing IoT systems with consideration for human factors and fitness for interfacing with humans
- research and development in IoT in the context of real-world projects

On this MSc course, unique and challenging modules will focus on IoT programming, IoT application development stack, systems for big data analytics, statistical data analysis, data mining, privacy and security, cloud computing, advanced programming for mobile devices, and advanced IoT with data science. All modules are designed to encompass the overarching themes of IoT, delivering research-informed teaching in lectures, tutorials, and laboratory sessions.

Students will have the opportunity to work in state-of-the art labs including Internet of Things (IoT) Innovation Lab, Computing Enterprise Centre, and Ethical Hacking lab. Students will also have an excellent opportunity to carry out a dissertation project with national and international clients through these labs.

The teaching delivery team includes internationally-renowned researchers and practioners from all the relevant IoT areas, including sensors, communication, data engineering, data storage, big data analytics, cyber security and visualisation. We have secured multi-million-pound research funding in IoT related projects, ensuring students be exposed to cutting-edge knowledge and case studies through teaching content and the student projects linked to these projects.

Our IoT related projects are funded by European (European Union, European Space Agency), International (Newton, NASA) and UK research councils (Innovate UK) in the following topics:

- Smart cities (European Union)
- 5G (European Union)
- Big data (Innovate UK, EU)
- Visualisation (NASA, European Space Agency, NHS, Innovate UK)
- Digital Healthcare (Newton Fund)
- Cyber Security (Innovate UK, West Yorkshire Police)

Our teaching is research-led, and students will have opportunity to learn from these real-world, cutting-edge live projects. In addition, the researchers teaching this course work closely with two national centres located in Bradford: Digital Catapult Centre,

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Economist Intelligence Unit.

and Digital Health Enterprise Zone (DHEZ) giving students access to the events and projects originating from these centres.

This course is also strongly aligned with the strategic academic themes of the University giving students benefit of the inter-disciplinary research carried out in the university:

Programme's Focus Themes	Related University Strategic Theme(s)
Theme 1. IoT for Healthcare	Advanced Healthcare
Theme 2. IoT for Smart Cities	Sustainable Societies
Theme 3. IoT for Industry 4.0	Innovative Engineering

Programme Aims

The programme is intended to:

- Enable graduates to develop deep knowledge and expertise in the modern world of IoT and smart cyber physical systems.
- Provide industry with graduates able to develop solutions to address challenges in developing complex IoT and smart cyber physical systems.
- Prepare graduates to carry out research in IoT systems

Programme Learning Outcomes

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

LO1 Demonstrate a systematic understanding and critical awareness of discipline knowledge in IoT systems development.

LO2 Demonstrate an understanding of advanced techniques applicable to their research and development projects on IoT applications

LO3 Demonstrate ability of evaluating existing methodologies in the literature and proposing new methodologies for addressing challenges of IoT systems development.

LO4 Communicate the results and conclusion on IoT systems development clearly to specialist and non-specialist audiences.

LO5 Demonstrate the independent learning ability required for continuing professional development.

LO6 Demonstrate ethical implications of technological advancement and usage with regard to the Internet of Things

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

LO7 Deal with complexity in IoT projects for design, development and deployment.

LO8 Demonstrate originality in the application of principle and knowledge on IoT stack and analytics, together with a practical understanding of applying IoT stack and analytics to generate new knowledge in the discipline

Additionally, to be eligible for the award of Degree of Master at FHEQ level 7,

students will be able to:

LO9 Demonstrate skills to select, design, plan and manage a self-directed and managed research-informed original project, demonstrating a critical analysis and evaluation of relevant material and the ability to apply relevant skills and research methodologies in the production of an advanced report.

Curriculum

Postgraduate Certificate

FHEQ Level	Module Title	Core/ option/ elective	Credits	Semester	Module Code
7	Software Development (PG)	O	20	1	COS7009-B
7	Internet of Things	C	20	1	COS7039-B
6	Cyber Security	C	20	1	COS6008-B
7	Big Data Systems and Analytics	O	20	1	COS7006-B
7	Mobile Application Development	O	20	1	COS7025-B

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.

Postgraduate Diploma

FHEQ Level	Module Title	Core/ Option/ Elective	Credits	Semester	Module Code
7	Advanced IoT (Data Science for IoT)	C	20	2	COS7043-B
7	Cloud Computing	C	20	2	COS7044-B
7	Data Mining	O	20	2	COS7028-B
7	Statistical Data Analysis	O	20	2	COS7005-B
7	Advanced Programming for Mobile Devices	O	20	2	COS7033-B

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.

Degree of Master

FHEQ Level	Module Title	Core/ Option/ Elective	Credits	Semester	Module Code
7	Dissertation	C	60	3	COS7004-E

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.

Learning and Teaching Strategy

The programme utilises a range of learning methods to offer a personalised, research-led, and digitally rooted learning experience with a holistic, international focus. At the centre of this strategy is the focus on problem-solving through the use of creative, analytical, logical and innovative thinking, and through networking and communicating effectively with peers.

The teaching delivery team includes internationally-renowned researchers and practioners from all the relevant IoT areas, including sensors, communication, data engineering, data storage, big data analytics, cyber security and visualisation. We have secured multi-million-pound funding in IoT related projects, ensuring students will be exposed to cutting-edge knowledge and case studies. Our teaching is research-led, and students will have opportunity to learn from these real-world, cutting-edge live projects.

Formal lectures will facilitate the acquisition of knowledge and understanding, discipline specific skills, and apply this learning to industry practices. Laboratory sessions, using three state-of-the-art, purpose-built laboratories run in conjunction with the theoretical components, give students the opportunity to enhance their understanding of particular topics. The unique teaching content and delivery on the course is extremely well supported with state-of-the-art, special purpose labs including IoT Innovation lab, Ethical Hacking lab and Computer Enterprise Centre. These will also help to develop discipline-specific skills and personal transferable skills.

In addition, the research and development carried out in these labs and the case studies from the publicly-funded high profile projects, ensures that the content is fresh and cutting-edge. We also integrate knowledge and experience from Industrial partners through both our Industry Advisory Board and these research projects through challenging case studies, lab-based activities and invited talks, ensuring that research findings are at the heart of our curriculum. This new programme will also involve invited external speakers from various industry sectors. This ensures students will be exposed to the very latest and future developments.

In addition to the standard technology-enhanced learning approaches, we embed technologies to deliver key concepts in an interactive environment that enhances student's experience in developing IoT products. For example; extensive use of simulation for product design and use of cloud and big data testbeds to support hands-on learning.

Assessment Strategy

Assessment for this programme is designed to develop research and development skills in the area of IoT in addition to more generic professional transferable skills such as critical thinking, team working, communication, leadership and decision-making. The overarching theme of the assessment on the programme is to support learning by offering students plenty of opportunities to receive feedback through formative assessment components, and by linking the assessments to real-world use cases and problems. The assessment strategies include group/collaborative work, individual assignments, examinations, research paper/report writing, and lab-based exercises. The final project/dissertation provides a significant opportunity to demonstrate their capability and skill in IoT systems development.

Assessment Regulations

This Programme conforms to the standard University Regulations which are available at the following link:
http://www.bradford.ac.uk/aqpo/ordinances-and-regulations/

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 standard entry requirements for the programme are as follows:

Applicants are expected to possess a good Honours degree (normally 2:2 or above) in computer science, computer engineering, informatics or other computer-related subjects from an approved degree-awarding body.

In addition, a test of written and spoken English normally needs to have been passed at grade 6.0 for IELTS or 550 for TOEFL (or 250 for the computer-based test) or above.

Applications are welcome from students with non-standard qualifications or mature students (those over 21 years of age on entry) with significant relevant experience.

Recognition of Prior Learning

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.

Minor Modification Schedule

Version Number	Brief description of Modification	Date of Approval (Faculty Board)