Queen Mary University of London

Programme Specification (UG)

Awarding body / institution:	Queen Mary University of London and Beijing University of Posts and Tele
Teaching institution:	QMUL and BUPT
Name of final award and programme title:	BSc (Eng) Intelligent Science and Technology
Name of interim award(s):	
Duration of study / period of registration:	4 years
QMUL programme code / UCAS code(s):	UBNF-BEELEC1/USIST - H6N7
QAA Benchmark Group:	Engineering, but benchmarks subsumed by UKSPEC
FHEQ Level of Award :	Level 6
Programme accredited by:	
Date Programme Specification approved:	
Responsible School / Institute:	School of Electronic Engineering & Computer Science

Schools / Institutes which will also be involved in teaching part of the programme:

School of Electronic Engineering & Computer Science

Collaborative institution(s) / organisation(s) involved in delivering the programme:

BUPT

Programme outline

This programme comes as a response to the growing research and commercial interest exponentially for autonomous and intelligent robot, information processing and machine learning that are based on the principles of the Intelligent Science and Technology (IST). This is a comprehensive programme covering the applications needed for building complete IST applications, such as industrial automation and cognitive robotics, human-computer interaction, man-made system technology, natural language processing, computer vision and gaming etc.

The programme focuses on computer science's foundation and support, combined with other disciplines, such as microelectronics, creative computing, and economics management. It emphasises on the necessary fundamental and practical knowledge for creating, designing, implementing, maintaining, and managing IST systems. At the same time, it will keep pace with information industry's development in terms of course construction, and constantly adapting to social changes while ensuring the ethic and safety of AI.

In addition to the technology, the programme will also include the key skills aspects already incorporated into the other JP programmes that were specifically commended by the QAA.

Programme Title: BSc (Eng) Intelligent Science and Technology

Aims of the programme

The programme sets out provide graduates with:
- a solid fundamental knowledge about computer sciences including data analytic, AI, machine learning and simulation modelling;
- an understanding of network architecture, design, planning and optimisation principles for IST;
- a knowledge of theory, methodology and techniques for IST assessment, evaluation and validation;
- a good overall understanding of computer and intelligent system development skills. This new interdisciplinary programme will provide graduates with a broader employment scope, covering the field of computer science, machine intelligence, human-computer interaction, robotics, visual computing and related management.
- a good understanding of the social schemes, health, ethic and safety underlying IST applications.

As the IST applications continue to increase exponentially, the career prospects span enormously especially in the IST research, software engineering, data scientist and user experience roles for various industries. Roles within IST discipline are very niche, requiring both an advanced technical background, machine, data science knowledge and extensive hands-on experience. Therefore, the balance of IST skills make the greatest asset underpinning many real-world applications.

What will you be expected to achieve?

At the end of his/her degree, each student should be able to demonstrate the following abilities:
• the ability to recall factual knowledge and the ability to apply it in familiar and unfamiliar situations;
• the ability to apply scientific, mathematical and software 'tools' to a familiar or unfamiliar situation;
• the ability to use Information Technology as a key tool pervading all aspects of Intelligent Science and Technology;
• the ability to understand practical issues concerning real systems (whether hardware or software);
• the ability to recognise insufficient existing knowledge and the ability to search for the necessary scientific, mathematical and software 'tools' relevant to that particular issue;
• the ability to work as part of a team;
• the ability to manage time effectively;
• the ability to appreciate the financial background against which decisions are made in industry;
• the ability to show a certain level of reflection on the role of engineering in society;
• the perceptive skills needed to understand information presented in the form of technical diagrams, flow-charts and high-level languages;
• the practical skills needed to implement a piece of hardware or software and to use laboratory test equipment;
• the analytical skills needed to verify the correct behaviour of a hardware or software system or component and to be able to identify faults;
• the design skills needed to synthesise a design (in hardware and/or software) from a specification (including the choice of the best option from a range of alternatives), to implement the design and to evaluate the design against the original specification;
• the written and oral communication skills needed to present information, in particular written information, effectively;
• the critical reasoning skills needed to appraise a particular topic;
• the ability to research and troubleshoot complex issues in such system systematically and communicate their conclusions clearly to specialist and non-specialist audiences.

Context-based aims and objectives:

• To be able to identify and apply the key principles (e.g. standard logics, neural networks, classification, signal and image processing, computer vision, advanced neural networks) to convert and formalising data into useful information, and to further developing intelligent systems;
• To be able to use mathematics, statistics and algorithms to systematic analysis hardware and software for IST systems e.g. use of complex numbers, matrix algebra, differential equations, transform theory, neural networks, quantificational logics, Monte Carlo Tree search, Evolutionary Algorithms, and many more to analysis, knowledge and reasoning, and decision making capability;
• To be able to apply embedded system, deep learning, computer vision, machine perception, smart control and robot, and intelligent visual information processing into useful representation for IST applications;
• To be able to develop, provide and maintain IST services, infrastructure and products for society, within the constraints imposed by economic, legal, social, cultural and environmental considerations;
• To be able to discuss the current and emerging concept e.g. deep learning, computational creativity, natural language

processing, AI in games for development of interactive IST application;
• To be able to identify issues and requirements in the practice of IST engineering activities, such as ethical issues and safety (e.g. AI-enabled fakery and forgery);
• To be able to demonstrate the use of appropriate design methodology, programming tools and techniques necessary for structuring IST applications;
• To be able to apply essential business management skills for managerial careers in IST industry and other technology-driven companies at the global level.

Please note that the following information is only applicable to students who commenced their Level 4 studies in 2017/18, or 2018/19

In each year of undergraduate study, students are required to study modules to the value of at least 10 credits, which align to one or more of the following themes:

- networking
- multi- and inter-disciplinarity
- international perspectives
- enterprising perspectives.

These modules will be identified through the Module Directory, and / or by your School or Institute as your studies progress.

Academic Content:	
A 1	Knowledge and understanding of scientific principles and methodology necessary to underpin their education in their engineering discipline, to enable appreciation of its scientific and engineering context, and to support their understanding of historical, current and future developments and technologies. This LO is mainly covered in year 1 and year 2 modules to provide a solid foundation, reinforce understanding and appreciate of mathematical, physics, knowledge representation, reasoning and decision making principles in IST related engineering problems.
A 2	Knowledge and understanding of mathematical principles necessary to underpin their education in engineering discipline and to enable them to apply mathematical methods, tools and notations proficiently in the analysis and solution of engineering problems. This LO is covered in many modules with particular emphasis being given in years 1 and 2 through modules such as: Advanced Mathematics 1/2, Linear Algebra.
A 3	Understanding of engineering principles and the ability to apply them to analyse key engineering processes.This LO is covered in many modules across all years of study to provide a solid foundation for systematic analysis of the IST engineering and processes. For examples in Visual Computing applies vision information processing, visual analytics and interactive visualization and computer vision, with underpinning visual computing mathematic, algorithm and applications enabled by AI to analyse the energy efficiency of the visual computing in IST applications.
A 4	Ability to apply quantitative methods and computer software relevant to the engineering discipline, in order to solve engineering problems. Quantitative methods, logics and computer software are used in many modules to solve IST related engineering problems. For example in Visual Computing, deep learning-based high level vision problem is used in evaluating the system performance in given IST scenarios, and also in Project. In Database Systems, students can apply SQL or NoSQL to extract data and information from structured and semi-structured database management system. In Machine Learning, students are required to apply quantitative methods or computer software and discuss the relative merits of different machine learning techniques and approaches. Additionally, in Reasoning and Agents, propositional logic is used for various extensions of standard logics relating to representation, reasoning and planning for solving real world problems.

A5	Understanding of a systems approach to engineering problems and to work with uncertainty. This LO is covered in many modules for students to apply systematic approach to solve IST related engineering problems. For example in Data Structures module, students could use decision tree technique to organise, manipulate and select data structures for specific IST applications. Meanwhile in Project, students typically follow a top-down approach, devising a functional specification derived from requirements capture, before proceeding to an implementation and subsequent evaluation.
A6	Understand customer and user needs and the importance of considerations such as aesthetics. Understand customer and user needs while conserving the needs of natural sciences are important aspects in IST degree programme and they are mainly covered in software related modules. Specific examples include AI Law that provides non-regulatory mechanisms (standards and best practices) with regards to development and deployment of AI technologies across different sectors. Software Engineering focuses on understanding the user requirements and needs and development during the software development process. In Project and EBC6014 (Engineering Environment), students need to establish the user/customer needs by carrying out requirement analysis and/or literature survey.
A7	Awareness of appropriate codes of practice and industry standards. This LO of appropriate codes of practice and industry standards related to IST engineering discipline is covered in number of modules. For examples in EBU5107 (AI Law) and EBC6014 (Engineering Environment) various related standards will be covered in the lectures.
A8	Awareness of quality issues. The awareness of quality issues are covered explicitly in number of modules. For examples, the quality issues is introduced through BBC3502 (Computer Fundamentals and Programming) and EBC3002/4002/5002 (Personal Development Plan & Entrepreneurial Skills) modules where students are required to demonstrate an awareness of quality issues, and consider the quality issues in the Design and Build product development in EBC6014 (Engineering Environment).

Disciplinary Skills - able to:	
B1	Ability to apply and integrate knowledge and understand of other engineering disciplines to support study of their own engineering discipline. This LO is mainly covered in year 3 and year 4 modules to apply and integrate science and engineering principles to support the study of IST related discipline. For examples the use of mathematics, data structures and mining, and signals in modules such as Operating Systems, BBC6601 (Natural Language Processing), and EBC6014 (Engineering Environment) which provide the appreciation of other engineering principles and apply to IST related AI problems and scenarios.
B2	Ability to identify, classify and describe the performance of systems and components through the use of analytical methods and modelling techniques. This LO focuses on applying the methods and algorithms learnt in year 3 to describe the system performance using IST related discipline in year 4. For example, the Machine Learning, Visual Computing, Embedded System and Database Systems apply deep-learning, classification, anomaly detection, systems programming with hardware features in the devices to identify, classify and visualise the information in IST-related services and devices.
B3	Investigate and define a problem and identify constraints including environmental and sustainability limitation, health and safety and risk assessment issues. This LO is covered by many modules across all 4 years. For examples, the environmental and sustainability limitations are explicitly considered within EBC4002 and EBC5002 (Personal Development & Entrepreneur Skills 2& 3). Health, ethics and safety of AI is covered in AI Law. Furthermore, students are required to provide environmental and risk assessment reports along with their project final report. Various legal risks are covered in EBC6014 (Engineering Environment).
B4	Identify and manage cost drivers. Cost drivers are covered in number of modules from year 2 onward. For examples, Engineering and Engineering Environment explicitly cover how to manage the cost drivers and budget in IST applications .
B5	Use creativity to establish innovative solutions. This LO is covered in many modules in IST degree scheme to solve and present the innovative solutions related to IST scenarios. For examples, Project requires the students to use creativity to produce their own solution to a given scenario.

B 6	Ensure fitness for purpose for all aspects of the problem including production, operation, maintenance and disposal. This LO is covered in several modules. In a software context, EBU5314 (Software Engineering) considers the complete software life cycle, including re-usability. Fitness-for-purpose is also implicitly covered in all student project activities, such as EBC6014 (Engineering Environment). Environmental impact, including disposal, is a core element of the final-year project.
B 7	Manage the design process and evaluate outcomes. This LO covered in many modules in IST Engineering degree scheme. This LO covered in many modules in IST Engineering degree scheme. More specific examples are EBU5314 (Software Engineering) where students are required to monitor the development process to avoid any slippage. Students are required to exercise the product development which including product planning, concept development to robust design and ramp-up. Meanwhile ECS6351 (Project) requires students to plan a complex project using tools to cope with uncertainly, whilst meeting deadlines. Students must also evaluate their solutions, reflecting on the final outcome.
B 8	Knowledge of characteristics of particular materials, equipment, processes, or products. This LO is covered in many modules including those specifically related to IST Engineering discipline. For examples, in Operating Systems the architecture and functions of operating systems such as system boot, Process and Threads, Synchronisation and Real-Time CPU Schedulling are covered in lectures; in EBU5477 (Embedded Systems), various features of different microprocessors and how to choose a proper interfaces or connections for different applications are discussed in the lectures.
B 9	Ability to work with technical uncertainty. This LO is covered in number of modules. It is first introduced in BBC4102 (Introduction to Electronic Systems) and BBC4924 (Physics C). It is then apply into more practical environment in ECS6351 (Project) where students required to conduct risk assessment exercises in technical uncertainly.
B 10	Produce a coherent technical presentation in written or oral form; This is explicitly addressed in Personal Development Plan & Entrepreneurial Skills (EBC3002/4002/5002) and the Final Year Project (ECS6351).
B 11	Present a coherent argument; covered in a number of modules culminating in the Final Year Project viva. After the presentation the student is cross-examined to assess aspects such as focal knowledge, context awareness and the appropriateness of the assessment methodology
B 12	Acquire and apply knowledge in a rigorous way to new and unfamiliar situations; This is undertaken in many core technical modules and also business module, where complex situations are explored. Realistic case studies are presented and students use skills and knowledge they have acquired to determine the best course of action.
B 13	Use quantitative data in analysis and synthesis in engineering problems. This is addressed in many modules including: BBC4941 (Probability Theory and Stochastic Processes), BBC4114 (Discrete Mathematics), and CBU5201 (Machine Learning).

Attributes:	
C 1	Knowledge and understanding of commercial and economic context of engineering processes. The LO of the awareness of the commercial and economic aspects of engineering is covered across 3 modules, particularly EBC6014 (Engineering Environment). Additionally, the final-year project contains the budgetary constraints, requiring students to justify expenditure and operate within a commercially constrained environment.
C 2	Knowledge of management techniques that may be used to achieve engineering objectives within that context. The knowledge of management techniques and develop the students' management skills in term of team working, team playing and communications are explicitly covered in all the PDP (Personal Development Plan & Entrepreneurial Skills 1/2/3). Other modules also incorporate this LO explicitly, for examples EBU5314 (Software Engineering) requires students to work as a team to develop an artifact.
C 3	Understanding of the requirement for engineering activities to promote sustainable development. This LO is covered in number of modules in Intelligent Science and Technology degree scheme. For examples in EBC4002/5002 (Personal Development Plan & Entrepreneurial Skills 2/3) have integrated part of this LO in the coursework.

C 4	Awareness of the framework of relevant legal requirements governing engineering activities, including personnel, health, safety, and risk (including environmental risk). This LO is covered by number of modules, specifically in EBC5002 (Personal Development Plan & Entrepreneurial Skills 3) and ECS6351 (Project), where students are required to prepare documentation related legal requirements such as Risk Assessment and health and safety Assessment.
C 5	Understanding of the need for a high level of professional and ethical conduct in engineering. The understanding of high level of professional and ethical conduct in engineering is covered in many modules. For examples, in EBC4002/5002 (Personal Development Plan & Entrepreneurial Skills 2 and 3) where Engineering Ethics will be covered specifically in the lectures.
C 6	Understanding of contexts in which engineering knowledge can be applied (e.g. operations and management, technology development, etc). A couple of modules bring out the LO directly within a coursework requirement where students need to consider manufacturing processes, planning control and product development as part of the assessment. The students will also be able to explain how and in which contexts technology can be developed and deployed (covered in EBU5477 Embedded System).
C 7	Understanding use of technical literature and other information sources. This LO is covered in many modules to develop the skills of technical literature reading and finding. For examples in EBU5477(Embedded System) requires students to refer to the design user manual of common ARM Cortex processor in labs; and in EBU6307 (Visual Computing), students are required to review and apply neural networks, gradient-based optimisation and automatic differentiation as a tool for modern IST applications.
C 8	Awareness of nature of intellectual property and contractual issues. The awareness of nature of intellectual property and contractual issues are covered in number of modules. For example, EBU5107 (AI Law) has discussions about AI contract law and legal precedents around the world.

How will you learn?

All taught courses involve lectures, problem solving coursework, laboratory work, case study and independent study. Lectures are used to introduce principles and methods and also to illustrate how they can be applied in practice. Coursework allows students to develop their skills in problem solving and to gain practical experience. Laboratory work provide students with the guidance and help while solving a problem using a wide range of tools and techniques. This allows students to learn-by-doing in order to complement the lectures. QM Graduate Attributes are available for all JP students to identify students' attributes and develop students' knowledge, skills and behaviour that employers' value.

How will you be assessed?

The assessment of the taught course units takes place through a written examination and practical coursework. Some courses also include in-class tests as a component in assessment.

The final year project is examined on the basis of a written report, a formal oral presentation, and a demonstration of the piece of software or hardware developed by the student. In addition to the final year project, other modules introduce project and group working skills.

How is the programme structured?

Please specify the structure of the programme diets for all variants of the programme (e.g. full-time, part-time - if applicable). The description should be sufficiently detailed to fully define the structure of the diet.

Most modules are shown with a value of 15 credits. This is to simplify the procedure to fit the QM system. EBU modules are actually 44 contact hours instead of 33 so should count for more than 15 credits; BBx modules use Chinese credits that do not map exactly to QM credits. CBx modules are co-delivered by QM and BUPT. Personal Development Plan & Entrepreneurial Skills is marked as a Core module with no credits as it forms part of Engineering Environment which is a mix of QM and BUPT modules. Engineering Environment is worth 15 credits and counts 5% towards the award of Honours.

In addition there are more modules than in a degree in London in order to satisfy Chinese requirements - the module load is not symmetrical across semesters as the technical modules are balanced with the Chinese compulsory modules not shown.

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All modules are taught in English and every module must be passed for a degree to awarded (Chinese regulations) - so are all shown as core.

JP programme has two parts: technical content and compulsory courses. The degree is awarded on the basis of the technical content, but the compulsory part must be passed to get a degree to comply with Chinese MoE requirements.

Only modules shown on the QM transcript counting towards the award of Honours are included; Chinese compulsory courses are not shown in detail, nor are short summer semester modules, but these must all be passed for the award of the degree so a pass/ fail module is included to allow that to be handled at QM.

Note that each unit is assigned credits based on contact time; again these are Chinese requirements.

Academic Year of Study FT - Year 1

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
English Language and Study Skills 1	BBC4014	15	4	Core	1	Semester 1
Advanced Mathematics 1	BBC4911	15	4	Core	1	Semester 1
Personal Development Plan & Entrepreneurial Skills 1	EBC3002	0	3	Core	1	Semesters 1 & 2
Computer Fundamentals and Programming	BBC3502	15	3	Core	1	Semester 1
Linear Algebra	BBC4913	15	4	Core	1	Semester 1
English Language and Study Skills 2	BBC4023	15	4	Core	1	Semester 2
Advanced Mathematics 2	BBC4921	15	4	Core	1	Semester 2
Physics C	BBC4924	15	4	Core	1	Semester 2
Introduction to Electronic Systems	BBC4102	15	4	Core	1	Semester 2

Academic Year of Study FT - Year 2

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester

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Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Personal Development Plan & Entrepreneurial Skills 2	EBC4002	0	4	Core	2	Semesters 1 & 2
Communication Skills 1	BBC4106	5	4	Core	2	Semester 1
Discrete Mathematics	BBC4114	15	4	Core	2	Semester 1
Formal Language and Automata	BBC5XXX	15	5	Core	2	Semester 1
Introduction to AI	EBU4203	15	4	Core	2	Semester 1
Data Structures	BBC4208	15	4	Core	2	Semester 1
Communication Skills 2	BBC4107	10	4	Core	2	Semester 2
Introductory Java Programming	EBU4201	15	4	Core	2	Semester 2
Probability Theory and Stochastic Statistics	BBC4941	15	4	Core	2	Semester 2
Product Development and Management	EBU5608	15	5	Core	2	Semester 2
Database Systems	EBU5503	15	5	Core	2	Semester 2
Digital Circuit Design	EBU4202	15	4	Core	2	Semester 2

Academic Year of Study FT - Year 3

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Personal Development Plan & Entrepreneurial Skills 3	EBC5002	0	5	Core	3	Semesters 1 & 2
AI Law	EBU5017	15	5	Core	3	Semester 1
Machine Learning	CBU5201	15	5	Core	3	Semester 1

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Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Computational Creativity	EBU6308	15	6	Core	3	Semester 1
Operating Systems	EBU5204	15	5	Core	3	Semester 1
Software Engineering	EBU6304	15	6	Core	3	Semester 2
Reasoning and Agents	EBU6505	15	6	Core	3	Semester 2
Embedded Systems	EBU5477	15	5	Core	3	Semester 2
Visual Computing	EBU6307	15	6	Core	3	Semester 2
Data Mining	BBU6504	15	6	Core	3	Semester 2

Academic Year of Study FT - Year 4

Module Title	Module Code	Credits	Level	Module Selection Status	Academic Year of Study	Semester
Project	ECS635U	30	6	Core	4	Semesters 1 & 2
Big Data Processing	ECS640U	15	6	Core	4	Semester 1
Multi-Platform Game Development	ECS756U	15	6	Core	4	Semester 1
Neural Networks and Deep Learning	ECS659U	15	6	Core	4	Semester 2
Engineering Environment (AI)	EBC6014	15	6	Core	4	Semester 1
Chinese Compulsory Topics	BBF6000	0	6	Core	4	Semester 1

What are the entry requirements?

Pass the minimum entry requirements for BUPT. As a national key university, all entrants to BUPT must score above the top line in the Chinese national entrance examinations. In addition, BUPT's requirement is much higher than that and the level is approximately equivalent to the top 2-3% of the population in China of that age group.

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How will the quality of the programme be managed and enhanced? How do we listen to and act on your feedback?

The JP operates an Academic Committee which is responsible under the contract and MoE licence for all matters relating to the delivery of taught programmes at school level including monitoring the application of relevant QM policies and reviewing all proposals for module and programme approval and amendment before submission to Taught Programmes Board. Student views are incorporated in this Committee's work in a number of ways, such as through student membership, or consideration of student surveys.

The JP operates an Annual Programme Review of the taught undergraduate provision. The process is normally organised with the Director and co-Director of JP who responsible for the completion of the school's Annual Programme Reviews. Schools/ institutes are required to produce a separate Annual Programme Review for undergraduate programmes using the relevant Undergraduate Annual Programme Review process. Students' views are considered in this process through analysis of the module evaluations and SSLC comments. In addition BUPT conducts a biannual review of all programmes.

The Staff-Student Liaison Committee (SSLC) provides a formal means of communication and discussion between QM and BUPT and JP students. The committee consists of student representatives from each year in JP together with appropriate representation from staff within the QM and BUPT. It is designed to respond to the needs of students, as well as act as a forum for discussing programme and module developments. SSCLs meet twice a semester.

What academic support is available?

Induction and pastoral support is provided through BUPT. Students are organised into "classes" of 30 as in the usual Chinese model. Each class has a tutor who provides pastoral support. One male and one female tutor sleep on campus every night so there is 24/7 access to pastoral support.

Feedback mechanisms from students are: (i) directly to the lecturers (ii) to their tutor (as described above) and (iii) through an SSLC that meets twice a semester. Because of the large numbers of students, a separate SSLC is held for each cohort.
For every module, whether taught by QM or BUPT, formal office hour or tutorial slots are provided. In addition QM staff can give advice and supervision remotely using a variety of techniques including MS Teams, WeChat and Tencent Conference .

How inclusive is the programme for all students, including those with disabilities?

A specific disabled students support that complies with Chinese law is applied to this programme since the students are physically in China.

Programme-specific rules and facts

The Special Regulations for the JP apply to this programme.

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Links with employers, placement opportunities and transferable skills

There is an industrial advisory committee consisting of senior staff from the Chinese Industry. A dedicated Industrial Liaison Manager is part of the JP team to develop links with industry and industrial projects, to ensure that projects are appropriate and to monitor their progress. A good industrial project provides excellent experience for an engineering undergraduate. There is a compulsory internship for all year 3 summer students and frequent invited industry lectures to year 3 and 4 students.

To date the other JP between QMUL-BUPT has a record of 100% employment or PG education. In fact, most JP graduates (>80%) go on to PG education, including directly to PhD research. The JEI expectation would be the same.

Programme Specification Approval

Person completing Programme Specification:	Xianhui Che
Person responsible for management of programme:	Michael Chai
Date Programme Specification produced / amended by School / Institute Learning and Teaching Committee:	
Date Programme Specification approved by Taught Programmes Board:	

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