LEEDS BECKETT UNIVERSITY

Course Specification

MEng Mathematics and Computer Science

2016-17 (MEMCS)

Our courses undergo a process of review periodically, in addition to annual review and enhancement. Course Specifications are updated on an annual basis to include modifications approved through our University's quality assurance processes. This Course Specification provides an indication of the current curriculum. If any changes are made to material information an updated Course Specification will be made available.

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LEEDS BECKETT UNIVERSITY

Faculty of Arts, Environment & Technology

School of Computing, Creative Technologies and Engineering

Award and programme title: MEng Mathematics and Computer Science

Level of qualification: Level 7

Interim awards available:

Award	Title	Level
BSCH	*Mathematics and Computer Science*	6
BSC	*Mathematics and Computer Science*	6
Dip HE	*Mathematics and Computer Science*	5
Cert HE	*Mathematics and Computer Science*	4

Length and status of programme and mode of study

Programme	**Length (years) Status (FT/PT/SW)**	**Mode (campus-based / DL or other)**
MEng Mathematics and Computer Science	**4 Years FT**	**Campus-based**

Course Specification

Overview and Aims

The profiles of Mathematics and Computer Science have been raised in recent years, with a push to widen participation in Science, Technology, Engineering and Mathematics (STEM) and enhance the skills and knowledge base of the workforce in these areas. This is evidenced by the government requiring that school leavers without GCSE Maths at Grade C continue to study the subject (see e.g. https://www.gov.uk/16-to-19-funding-maths-and-english-condition-of-funding), by the shift from ICT to Computer Science courses at GCSE and A Level, and by the changes to the GCSE maths curriculum to improve levels of attainment.

It is expected that this course will attract students well able to rise to the challenge of the more rigorous approach demanded by Mathematics and Computer Science, and the demands of an integrated masters which incorporates progression through to postgraduate level within the same award.

The course is defined with 120 credits at each of levels 4, 5, 6 and 7. An extended Level 5, semester 2 will include up to a 30 week placement for those choosing the Applied Computer Science elective module. In preparing students for a career using mathematics or computer science chosen topics provide progressively deeper learning over the levels, with horizontal integration within levels ensuring a cohesive and deep learning experience. Course and level learning outcomes are designed to recognise the cumulative nature of mathematics and computer science, something highlighted explicitly in the MSOR SBS. Learning outcomes are also informed by the Leeds Beckett taxonomy of assessment domains for taught courses, allowing students to develop progressively across the domains as they increase their subject knowledge and abilities.

Modules at level 6 and 7 allow students' skills to be critiqued and applied to a broader range of areas e.g. Service Oriented Architecture, Developing Mobile Applications. In the mathematics component, in line with the MSOR SBS, there is specialization and increasing depth in the Computer Arithmetic Algorithms and Theory of Computation modules, and breadth from Topics in Analysis. Level 6 also incorporates a substantial team project, allowing students to develop as practising professionals.

At level 5 the incorporation of an extended semester 2 placement elective will also strongly address issues of employability and professional practice within the award. Students will be assessed on the outcome of this placement by the elective module Applied Computer Science. The course incorporates strong themes of logic and programming early on, including formal mathematical analysis of computer software, which will enable the students to offer a clear set of usable skills to employers in their placement or in undertaking a substantial client based project. The link between mathematics and software development through formal specification ensures scope for a computer science placement involving substantial mathematical content. Students who choose not to commit to the extended placement module will complete an equivalent client based project which will be assessed by the Delivering a Computer Science Project module. The other two modules in that semester will assess employability, professional practice, working on projects in industry and technical skills development gained from the experience of undertaking the placement or client based project. This will allow the students to consolidate theory into practice in the workplace or through client interaction and gain employability skills and should provide an opportunity to obtain job references from industry, invaluable after graduating. It is expected that these placements and client projects will be available as we have had comments from some employers at the Computer Showcases recently that they would value students who had a more rigorous background in programming in particular.

Throughout the course the strong mathematics of computation and programming theme will remain prevalent along with modules covering project management, software engineering and emerging technologies. The course will share modules with both the UG and PG

computing programmes whilst ensuring its unique role across both levels and coherence in the mathematics and computer science topics studied.

Course Learning Outcomes

1	Demonstrate a systematic understanding of the knowledge domains in mathematics and computer science and a critical awareness of current problems and/or new insights much of it at or informed by the forefront of the disciplines
2	Use originality in the application of knowledge in a professional environment, together with a practical understanding of how established techniques of research and enquiry are used to create and interpret knowledge in the discipline of computer science
3	Evaluate and critique methodologies, underpinning theories and practices within the fields of mathematics and computer science
4	Demonstrate self-direction, originality and creativity in tackling and solving practical problems from mathematics and computer science which have been planned and implemented within a global professional, legal, social and ethical framework
5	Exercise initiative and personal responsibility in dealing with complex and unpredictable situations, making sound judgements, communicating their conclusions clearly to specialist and non-specialist audiences
6	Demonstrate a high level of capability in using concepts and knowledge, and originality in applying results and techniques, from logic, algebra and analysis for formulating complex problems mathematically and developing logical arguments for their solution

Course Structure

Level 4
The course begins by setting the scene for study. As students may not have met computer science before Fundamentals of Computer Science introduces the history and issues of computer science and has an emphasis on study skills. Fundamentals of Computer Programming in the first semester covers fundamental concepts of programming with the concept of object oriented (OO) programming introduced in the second semester. Fundamentals of Mathematics is designed to ease the transition from school to university mathematics; this is widely recognised to pose difficulties as students move from an algorithmic and informal approach to one requiring abstract thinking and rigorous proof. Introduction to Mathematical Logic delves deeper into abstraction and proof, while Mathematical Modelling and Simulation provides an introduction to applied mathematics and mathematical software in the application area of digital circuit design.

Semester 1	Core (Y)	Semester 2	Core (Y)
Fundamentals of Computer Science	*Y*	Object Oriented Programming	*Y*
Fundamentals of Computer Programming	*Y*	Mathematical Modelling and Simulation	*Y*
Fundamentals of Mathematics	*Y*	Introduction to Mathematical Logic	*Y*

Level 5

Preparation for the second semester work placement or individual project begins early in semester one with a series of lectures and tutorials to support these activities. The topics of logic and programming are explored further, and abstract algebra introduced.

Semester 1	Core (Y)	Semester 2	Core (Y)
Software Development	Y	Developing the Mathematician and Computer Scientist	*Y*
Introduction to Algebra	*Y*	Projects in Mathematics and Computer Science	*Y*
Mathematical Logic	*Y*	Applied Computer Science	*N*
		Delivering a Computer Science Project	*N*

Level 6

A major team project takes place in level 6 which focusses initially on developing research skills and academic writing, the teams then call on the individual team member's research which is then used to influence the development of a team product. In the mathematics strand Algebraic Structures builds on earlier modules while Algorithms and Data Structures draws on students' earlier study of logic and algebra to explore one of the central applications of mathematics to computer science. In the computer science strand modules on distributed systems and mobile development both
broaden and deepen students' exploration of the subject. The modules marked "L6" provide an opportunity to study modules alongside master's students in the lectures for these modules; tutorials will be separate as the learning outcomes and assessments are specified at level 6.

Semester 1	Core (Y)	Semester 2	Core (Y)
L6 Service Oriented Architecture	Y	Algorithms and Data Structures	Y
Algebraic Structures	Y	L6 Cloud Computing Development	*N*

		L6 Developing Mobile Applications	N
Mathematics and Computer Science Project (40 credits)			
Course Structure – PGT			
Level 7			
As an integrated Masters course this final level of the course follows directly from Level 6 and has the same two-semester structure. It allows the students to focus on a major individual piece of work in the dissertation, supported by the project management module which is core to all our master's awards in the school. Core modules for computer science and mathematics provide a capstone to students' learning while electives in second semester offer an opportunity for students to follow their interests.			
Semester 1	Core Y/N	Semester 2	Core Y/N
Project Management	*Y*	Business Intelligence: Data analysis and visualization	*N*
Software and Systems	*Y*	Topics in Analysis	*N*
Theory of Computation	*Y*	Computer Arithmetic Algorithms	*N*
		Dissertation (40 credits)	*Y*

Learning and Teaching

Details relating to contact hours and other key information sets (KIS) are available on the course page of our Online Prospectus on our website.

Learning and Teaching Approaches

Learning and teaching methods provide high quality learning opportunities that enable students to demonstrate achievement of the learning outcomes of the Course through the learning outcomes of those modules. The course will share modules at both undergraduate and post graduate levels. Level 6 will be a cross over between undergraduate and postgraduate where students will study some modules with the masters students but written with level 6 learning outcomes. This approach will emphasise that it is an integrated masters and provide for a strong course identity. These modules specified at level 6 will share lectures for a similar module at level 7 with Master's students; these will be used to introduce the topic. However tutorials, other learning materials on the VLE and assessments will be separate and specifically based at level 6.

Teaching and learning methods increasingly promote the capacity for students to assume responsibility for their own learning and development, by the end of the course students will have developed high levels of personal responsibility, initiative, creativity, be able to demonstrate originality and critical awareness of current problems and new insights informed by the forefront of the computer science discipline.

Progressive use of dealing with complex and later unpredictable situations in projects and problem based learning will allow students to achieve this and take on greater self-direction of their learning. Having the placement at level 5 will allow students to have experience and understanding of the context of computer science in industry which will give the students real experiences to draw on.

Students will increasingly through the levels be expected to complete reading and research in the modules starting at level 4 with e-book chapters and practitioner papers (e.g. Computer Weekly, Computing, Mathematics Today, Mathematics Magazine) to reinforce and expand on topics covered in the timetabled sessions. At the later levels there will be increasing use of critiquing research papers and practitioner journal articles supporting critical thinking.

The assessment strategy and design recognises the computer science industry as a source of inspiration and seeks where possible to align academic work with professional practice. Throughout the four years students in their assessments will increasingly be required to demonstrate deeper learning, act more independently, collaborate more effectively, deal with complex issues in a systematic way, think more critically, use literature more effectively, synthesise and reflect more critically.

Learning and Teaching Activities

The Course employs a wide range of learning opportunities and teaching methods including the use of lectures, tutorials, practical work, work based learning, simulations, role play, case studies, projects, peer group interaction and self-managed teams. This range of activities should provide opportunities for students to use their preferred learning styles and support the development of less preferred learning styles, and some will through presentations and seminar discussions allow students to demonstrate their skills and understanding to their peers. Advantage will be taken of both technology and supportive activities to ensure that effective learning takes place. The VLE allows scope for students to access learning materials outside their contact hours, providing support for the remainder of the 200 notional learning hours for each 20 credit module. Students should feel that they are being challenged by the range and level of activities and assessments but should also feel supported and know how to access that support.

Feedback on learning and assessment activities will be both formative and summative for assessments, supporting students in reflecting on their progress.

During course team meetings the course team will reflect on these activities and their spread across the modules and levels and make adjustments to learning activities over time, student feedback will also be an important part of this.

Graduate Attributes (UG only)

This is an integrated Master's course and is expected to meet the graduate attributes of Enterprise, Digital Literacy and Global Outlook progressing developmentally over the first three years.

Digital Literacy: High levels of digital literacy will be developed across all modules to ensure confident and critical use of information and digital technologies to enhance academic, personal and professional development.

Computer literacy is an integral part of the course developing not only the ability to identify, adopt and use digital devices, applications and services in the fulfilment of activities, but also the ability to develop computer systems to support users in their employment of these tasks across global enterprises.

Academic practice will be developed appropriate to the levels and include the ability to study and learn effectively in technology-rich environments. In particular, academic report writing will begin in the Fundamentals of Computer Science module which will introduce the use of digital tools to support academic writing, referencing and citation and will include the use of and clear understanding of the output of plagiarism detection tools such as Turnitin. Information and media literacy will be further developed throughout the level 5 placement related modules, the level 6 team project and the level 7 dissertation: all of these assess students on their academic report writing skills ensuring they can find, access, evaluate and use digitised resources and also understand their authority, reliability and provenance, and increasingly think critically about the selection of such materials.

All modules utilise digital learning materials often within virtual learning environments or open access repositories which support independent study, assessment and feedback.

During teamwork starting in level 4 of the course in the Fundamentals of Computer Science module students will be encouraged to communicate electronically. However during the level 6 project it will be expected that the teams will utilise digital online communication and collaboration tools to provide an effective communication medium within the team and a repository for shared documents.

Being enterprising: Enterprising skills on the course will include both entrepreneurial skills and enterprising skills. Students will be equipped with creative and problem-solving skills which will mean they can take an enterprising and resourceful approach to their future careers and learning. Situated learning experiences will be embedded including work placements and live projects with local organisations, social enterprises and business people. During level 4, problem solving skills will be explicitly developed in all the modules. In line with the nature of the computing industry, and of business sectors making use of mathematics, problem solving skills will be utilised as part of most of the modules in the course. In level 5 much of the problem solving will be situated in the work context through placement and project work.

Having a global outlook: The nature of programming, computer systems provides an ideal situation in which to develop a global outlook. Global relevance is developed developmentally over the levels providing a global perspective to many of the areas of computer science and mathematics beyond the understanding that they provide support for organisations to be globally interconnected. Ethical considerations and cross-cultural capabilities are also developed at every level. For example at level 4 in Fundamentals of Computer Science students will be introduced to the BCS Code of Conduct and will consider

case studies on professional issues within the computer industry and other industries in order to gain a broad understanding of ethical considerations. Global issues around computer misuse will also be discussed within this module.

The placement and client based modules at level 5 will require students to work in a professional manner and the grounding gained at level 4 should support them in this and the assessments will include consideration of both ethical issues and global perspectives. There are 5 weeks of employability lectures delivered to all level 5 computing students in the school as preparation for placements and sandwich placements also includes discussion of ethical considerations and professionalism, although doesn't explicitly form part of any modules in the courses.

The team project at level 6 will require the implementation of the university ethical process for projects which is an online system of the student classifying the ethical considerations and then gaining ethical approval in order to start their project once initial research has taken place. Ethical approval is also a requirement of the level 7 dissertation. For both projects at level 6 and 7 students will also be expected to consider and reflect on the global context of their project work, including e.g. system security.

Use of the Virtual Learning Environment

All modules make use of the university VLE with most making extensive use by including a range of materials including copies of module guides, work books and assessments. In addition there is an expectation that additional support materials are provided e.g. links to e-books, websites, journals, technical support, quizzes, discussion areas for peer support, announcements, reassessment and deferral support etc. In some cases videos of lectures are included along with videos showing how to utilise various software tools. Assessments are uploaded to the VLE for plagiarism evaluation, marking and feedback. Students usually receive their module marks and individual feedback via the VLE. Few modules provide any paper based materials so the student experience is very much through the VLE. Modules also provide online access to required software allowing students to study away from the university.

Use of Blended-Learning

N/A

Assessment Strategy

Assessments on modules build on and reinforce previous study with increasingly more reliance on self-direction and critical thinking through the levels. The assessment types aim to reflect real world practice where possible, ranging from group and individual practical assignments to individual reports; tests and exams are also utilised, particularly in the mathematics modules where students will be familiar with this method of assessment. The assessment types of presentations, demonstrations of products, reports, online tests, group work, practical tests and exams are all reused a number of times during the course allowing the students to refine their skills and respond to tutor feedback. All levels include phase

examinations and traditional exams. Phase examinations act as a motivator to students and as a means of reducing plagiarism and collusion, particularly at lower levels to assess knowledge through quizzes and practical skills though timed practical work. Traditional examinations are used when it is considered that the theoretical underpinning being assessed would benefit from allowing the students the opportunity to provide longer narratives but under a time constraint.

The majority of assessment at all levels is through coursework, as seen in the extract from the KIS:

	Assessment Methods (% assessed by)		
Course stage	Written exams	Course-work	Practical Exams
1	26.67	73.33	0
2	25	75	0
3	32.5	67.5	0
4	30.55	62.78	6.67

Maintaining a good mix of assessment types will prove valuable preparation for graduates seeking professional recognition, since both coursework and examination based assessment strategies are used in the Chartered Mathematician and Chartered IT Professional schemes, and most specialist IT certifications use some form of examination. The assessment is designed to move steadily towards increased formality in the demonstration of what has been learnt: from workbooks and tests, through formal written and oral presentations of course and project work, examinations, and ultimately to the submission of extended project reports, formal presentation of academic papers, and dissertations.

The assessment schedule with dates will be issued to students at the beginning of each year allowing them to plan their academic work around any employment and other commitments.

Feedback on Assessed Coursework

All modules provide plenty of feedback opportunities. The practical nature of some of the coursework allows demonstration of assessment work to be incorporated into the assessment e.g. presentations and demonstrations of products developed. This supports development of communication skills for the student and allows in-depth questioning on the product and its development. It is also an opportunity for immediate feedback by the tutor.

Students are encouraged to obtain formative feedback of assessments from their tutors, and some modules have a suggested submission date for formative submissions via the VLE for more extensive written formative feedback. This can particularly support the development of academic report writing skills although the level of support offered has to be balanced against the requirement for more self-direction in the later levels of the course.

Written feedback for summative assessments is given against the defined assessment criteria (available to the students via the VLE). Feedback would usually be provided electronically although students are encouraged to discuss their feedback with the module tutors.

Personal tutors, in addition to meeting during the semesters, will meet each of their tutees at the end of each semester to review their performance, which is discussed in detail and advice given on their progress.

Module Assessment Methods

Module Titles	***Core (Y)***	*(A) End Exam*	(B) *Phase Exam*	(C) *Course Assessment*	(D) *Project*	(E) *Dissertation*	(F) *Final Project*	(G) *Placement File*
Fundamentals of Computer Science, level 4	Y			60 40				
Fundamentals of Computer Programming, level 4	Y			40 60				
Fundamentals of Mathematics, level 4	Y	60		40				
Object Oriented Programming, level 4	Y			40 60				
Mathematical modelling and simulation, level 4	Y			40 60				
Introduction to Mathematical logic, level 4	Y	60	40					
Software Development, level 5	Y		40	60				
Introduction to algebra, level 5	Y	70	30					
Mathematical Logic, level 5	Y	50		50				
Developing the Mathematician and Computer Scientist, level 5	Y			40 60				
Projects in Mathematics and Computer Science, level 5	Y			50	50			
Applied Computer Science, level 5	N							100
Delivering a Computer Science project, level 5	N				100			
Mathematics and Computer Science Project, level 6	Y				40 60			

L6 Service Oriented Architecture, level 6	Y			50 50				
Algebraic structures, level 6	Y	70	30					
Algorithms and data structures, level 6	Y	70		30				
Developing Mobile Applications, level 6	N			40 60				
Cloud Computing Development, level 6	N	50		50				
Project Management, level 7	Y	50		50				
Software and Systems, level 7	Y			100				
Theory of Computation, level 7	Y	70		30				
Dissertation, level 7	Y		20			80		
Business Intelligence: data analysis and visualization, level 7	N		20	80				
Topics in Analysis, level 7	N	70	30					
Computer Arithmetic Algorithms, level 7	N	70		30				

Employability and Professional Context

The course will apply for accreditation by the BCS and has been influenced by the requirements of accreditation; in particular, the requirement of a team project at level 6 has been implemented.

The course has been designed to provide for students wanting to embark on a computing career but who wish to have a deeper understanding of the mathematical underpinnings of computing than is usually covered in a single honours course. This makes the course particularly suitable to students who wish eventually to pursue a career combining mathematics and programming: formal methods, scientific programming, computational mathematics, systems programming etc.

The course incorporates a supervised industrial placement for those choosing the placement elective during the second semester of their second year of studies; this will allow them to further develop their technical and employability skills. At the beginning of the second year the students will undertake a series of lectures and tutorials to introduce them to the requirements of the placement or client based project, help them assess their current employability skills and support them in securing an appropriate placement or client based project. The placement and client based project will be assessed by three modules in the second semester of year 2 and the preparation sessions will also prepare the students for these modules e.g. in how to record and evaluate activities undertaken and approaches to reflection on the placement and within projects.

Students in the school are encouraged to undertake projects or volunteering opportunities with outside organisations and at level 6 and above are encouraged to undertake additional projects for external clients where possible.

The Employers Forum in the school, the series of lectures by computer professionals and the level 6 Showcase are all examples of regular contact with employers and the demands of industry. The recent 2014 Undergraduate Computer Showcase attracted 50 guests with IT specialists, members of the business community and potential employers from across the region. It began with an introduction from the guest speaker, Jonathan Healey, Divisional Managing Director of web development and digital marketing agency NetConstruct Ltd, followed by student presentations. It is expected that this course will form part of this event with students presenting their team projects.

In addition to the employability skills that will be gained as a result of doing the course, and the placement or client project within the course, access is available to our Employability and Progression Team which is a careers advisory service and employment agency combined into one. Our team of experts can help students to make well-informed decisions about student and graduate employment or postgraduate study. Through their vacancy database, regular careers & jobs fairs and their employer links, students will be supported in accessing employment and postgraduate study opportunities. Practical help and resources are also available to assist in exploring and researching careers, job hunting and presenting themselves professionally in CVs, applications and interviews in an increasingly competitive market.

Work-Related Activities

The nature of computer science lends itself to providing practical learning and assessment tasks, including mathematical elements, which require students to actively apply skills and knowledge preparing them for future employment. Employability is further enhanced by the use of the Graduate Attributes to guide the design of learning, assessment and project work since these attributes are specifically designed to enhance a student's employability as well as their experience of learning.

The assessment strategy ensures students are completing authentic tasks via realistic case studies and projects across most of the modules. These challenging tasks are designed to stretch students' capabilities, encourage deep learning, authenticate the application of theoretical knowledge into practice and simulate the working environment including taking part in team working activities. In the mathematics strand some modules are necessarily strongly theoretical, but even here students meet practical applications either later in the same module or in other modules studied. Team working will begin at level 4 in Fundamentals of Computer Science and the placement or client based project should also prepare the students for undertaking the level 6 team project and dissertation at level 7 which are both characterised by complex tasks investigated by students over a sustained period of time.

The placement will involve up to 30 weeks working in industry during an extended semester 2 in the second year. The students will be well prepared for this in terms of expectations of professionalism, finding a placement and the requirements of the 3 modules which assess the placement. A briefing document is provided to students covering how to get a placement, payment and arrangements for dealing with the situation where a placement ends early. Each student will be assigned an industry placement supervisor as well as an academic who will be their placement supervisor; this ensures students are well supported and know who to contact should any issues arise. The academic placement supervisor will keep in contact with the student and the industry supervisor and make at least two visits. All the school's degrees include a supervised placement so academics and admin support are well used to providing this type of support.

Students who are unable to undertake the extended placement activity will take the elective of Delivering a Computer Science Project which will focus on the delivery of a client based project; this is likely to be a mathematics focused computer science project since computer science provides many opportunities for the use of mathematics. Students will be allocated a project supervisor who will meet them regularly, help them in planning and meeting milestones, liaise with the client where necessary and generally support them in completing their project. Planning and documenting the process of delivering the project will be assessed in the Computer Science Project module and the development and assessment of employability skills will be assessed in Developing the Mathematician and Computer Scientist.

Placement or Work-Related Activity Level:

Industrial Placement will take place immediately after the 1st semester in year 2.

Placement or Work-Related Activity Length in Weeks:

Up to 30 weeks

Type of Placement or Work-Related Activity:

The industrial placement will be assessed by the 3 modules in the second semester of year 2.

Reference Points used in course design and delivery

All our courses leading to Leeds Beckett University awards have been designed and approved in accordance with UK and European quality standards. Our courses utilise the Frameworks for Higher Education Qualifications (FHEQ) and relevant subject benchmarks (where these are available) and professional, statutory and regulatory body requirements (for professionally accredited courses).

We review our courses annually and periodically, responding to student feedback and a range of information to enhance our courses. Our University is also subject to external review by

the Quality Assurance Agency. Our latest report can be found on the QAA website at http://www.qaa.ac.uk/reviews-and-reports

We appoint External Examiners to verify that our University sets and maintains standards for awards which adhere to relevant national subject benchmark statements and the FHEQ (UK), ensure standards and student achievements are comparable with other Higher Education Institutions in the UK, with which they are familiar, and ensure that assessments measure achievement of course and module learning outcomes and reach the required standard. External Examiners may also provide feedback on areas of good practice or potential enhancement.

Record of Enhancement

No.	Detail of modification (Provide a brief description of the modification and where the Course Specification has been updated)	Date Effective (Indicate the academic year of entry and course level(s) to which the modification will apply)
	Example Assessment changed from examination to presentation in Module X, see section entitled Module Assessment Methods.	Level 5 from September 2018-19 entry