

## 1. Programme Title(s): MSc / PG Certificate in Reliable Embedded Systems

2. Awarding body or institution:

University of Leicester

# 3. a) Mode of study

Part-time (Blended learning)

# b) Type of study

Distance learning (Blended learning)

# 4. Registration periods:

The normal period of registration is: 2 years and 3 months (MSC), 2 years (PG Cert) The maximum period of registration is: 4 years (MSc), 3 years (PG Cert)

# 5. Typical entry requirements:

Normally a candidate will be expected to hold an undergraduate degree (e.g. BSc, BEng) in an appropriate related discipline from a UK University, or recognised international equivalent, at the level of second class honours (2:2) or equivalent.

In exceptional cases where a candidate's degree is not in a related discipline, or a candidate does not meet the degree requirements, significant directly relevant industrial experience may be taken into consideration as a compensating strength.

All teaching will be in English. Evidence of proficiency in English may be required where appropriate.

# 6. Accreditation of Prior Learning:

Candidates may take EG7510 as a stand-alone CPD activity. If they register as a CPD delegate, they may engage with the advance study component of the module, and the block teaching week. They will not engage with the final (assessed) case study. They will be given feedback – but not formal marks – for laboratory work during the course of the week.

Candidates will have a 12 month period (equating to two entry points to the programme) to register for the MSc or postgraduate certificate. They will have the option to APL the credits for this module by completing the assessed case study (in the timetable/calendar slot matching new students, with the equivalent support) and obtaining a full marks profile for the module. A fees consideration may be applied in this case.

They may also elect not to APL the credits for EG7510, and to register for the complete programme. No time restrictions apply in this case, and no previous results are transferable. No fees considerations will apply in this case.

The same APL applies to the Postgraduate Certificate.

### 7. Programme aims:

The programme aims to provide the knowledge and skills required of a professional engineer to design reliable embedded systems, in a format and at a level that reflects state-of-the-art industrial practice. The course includes modules on programming, software architecture, field-programmable gate arrays, real-time operating systems and multi-core / multi-processor systems. Students should be able to:

- Demonstrate specific knowledge and understanding of advanced topics in reliable and realtime embedded systems and to be able to apply this knowledge in the design and implementation of real-world systems;
- Continue to develop their professional engineering education through CPD programmes of related areas;
- Work effectively as part of both multi- and single-disciplinary teams;
- Demonstrate clear communication skills and be competent users of IT communication techniques (e.g. oral presentation and report writing);
- Pursue research (MSc graduates only);
- Undertake the normal roles of Chartered Engineers in industry (MSc graduates only).

# 8. Reference points used to inform the programme specification:

- QAA Framework for Higher Education Qualifications in England, Wales and Northern Ireland
- QAA <u>Master's Degree Characteristics</u>
- QAA Benchmarking Statement Engineering (2015)
- PDR report (May 2008)
- University Learning Strategy
- University Employability Strategy
- Graduate Survey (2014)
- First Destination Survey
- External Examiner's Reports

## 9. Programme Outcomes:

# MSc in Reliable Embedded Systems

Intended Learning	Teaching and Learning	How Demonstrated?	
Outcomes	Methods		
(a) Subject and Professional skills			
	Knowledge		
Core knowledge of state-of-the- art architectures and techniques for reliable and real-time embedded systems.	Lecturer-driven seminar classes for each module, laboratory exercises and design classes, problem solving classes, background reading and directed independent reading of current research, on-line tutorial support.	Submission of design solutions and laboratory exercises, literature review reports, oral presentations, execution of large case study relevant to each module.	
Concepts			
Design of modern embedded systems contrast the relative merits of different designs (time triggered and event driven) with regards to reliability, and apply the range of techniques that may be used to achieve reliability.	Lecturer-driven seminar classes for each module, laboratory exercises and design classes, problem solving classes, background reading and directed independent reading of current research, on-line tutorial support.	Evaluation of design solutions and laboratory exercises, supported by oral presentations, execution of large case study relevant to each module.	

Outcomes         Methods           Techniques         Techniques           Practical demonstration of experimental methods and measurement techniques including collection of results. Competence use of a variety of current industrial design tools for CPU and FPGA platforms.         Practical demonstrations and bloratory exercises and applications in problem solving classes.         Demonstration of design solutions and laboratory exercises, for large case study relevant to each module.           Appraisal of different techniques used to design, analyse, and researce results of contrasting designs and techniques.         Laboratory practical classes and laboratory exercises, follow-up seminar classes and on-line teaching support.         Submission of design solutions evaluation and laboratory exercises, evaluation, oral presentations, project supports.           Ability to debate with supporting scientific and engineering evidence the relative merits of software, hardware, and design erdience the relative merits of software, hardware, and design engineering projects.         Supported laboratory exercises, group exercises and seminar discussions, project supervision.         Oral presentations and seminar discussion performance, final project report.           Constructive evaluation, analysis, and review of relative safety on ensits of end product embedded systems.         Submission of laboratory reports, directed private study and research, project supervision and evaluation.         Submission of course work and case studies for each module, project report.           Study skills, information management including iterative, serview, experimental design and data analysis. Comprehension of hardware/software descriptions and data sheets.	Intended Learning	Teaching and Learning	How Demonstrated?	
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Intended Learning	Teaching and Learning	How Demonstrated?
Outcomes	Methods	
	Problem solving	
Ability to define, catagorise, and investigate problems and challenges in construction of reliable embedded systems in relevant domains. Appreciation of evaluation of costs and implication of relative solutions in relation to wider engineering projects.	Project proposal supervision meetings. Project supervision meetings.	Project proposal and final project report.
Working relationships		
To be able to define and deliver the requirements, contributions, and limitations of a (reliable) embedded system in the wider context of a large engineering projects	Student led seminar and laboratory classes,project supervision meetings.	Assessment of group design exercises and related oral presentations, final project report.
	Managing learning	
Research and select appropriate architectures, techniques, and approaches for a specific engineering problem and relate it to large engineering project. Relate new research advances to existing knowledge.	Student led seminar and laboratory classes,project supervision meetings.	Timely submission of coursework and case studies; successful completion of novel project work including identifying the role of the contribution in a wider context literature review.
Career management		
Define and extend the use and role of reliable embedded systems as appropriate to an industrial context and industrial projects.	Project supervision meetings.	Application of a variety of techniques in a novel project proposal and project.

# Postgraduate Certificate in Reliable Embedded Systems

Intended Learning	Teaching and Learning	How Demonstrated?		
Outcomes	Methods			
(a) Subject and Professional skills				
	Knowledge			
Core knowledge of state-of-the- art architectures and techniques for reliable and real-time embedded systems.	Lecturer-driven seminar classes for each module, laboratory exercises and design classes, problem solving classes, background reading and directed independent reading of current research, on-line tutorial support.	Submission of design solutions and laboratory exercises, literature review reports, oral presentations, execution of large case study relevant to each module.		
Concepts				
Design of modern embedded systems contrast the relative merits of different designs with regards to reliability, and apply a range of standard techniques.	Lecturer-driven seminar classes for each module, laboratory exercises and design classes, problem solving classes, background reading and directed independent reading of current research, on-line tutorial support.	Evaluation of design solutions and laboratory exercises, supported by oral presentations, execution of large case study relevant to each module.		

Intended Learning	Teaching and Learning	How Demonstrated?	
Outcomes	Methods		
	Techniques		
Practical demonstration of	Practical demonstrations and	Demonstration of design solutions	
experimental methods and	execution of laboratory exercises and	and laboratory exercises, supported	
measurement techniques	applications in problem solving	by oral presentation, execution of	
including collection of results.	classes.	large case study relevant to each	
Competence use of a variety of		module.	
current industrial design tools for			
CPU and/or FPGA platforms.			
	Critical analysis	Cubraining of design colutions	
Appraisal of different techniques	Laboratory practical classes and	Submission of design solutions	
moscure results of contrasting	sominar classes and on line toaching	evaluation and laboratory exercise	
designs and techniques	support	evaluation, or a presentations.	
	Presentation		
Ability to illustrate some relative	Supported laboratory exercises, group	Oral presentations and seminar	
merits of software, hardware.	exercises and seminar discussions.	discussion performance.	
and design techniques.	project proposal supervision.		
	Appraisal of evidence		
Constructive evaluation and	Seminar discussions, experimental	Submission of laboratory reports.	
analysis of relative safety and	evaluation of laboratory exercises,		
merits of end product embedded	directed private study.		
systems.			
	(b) Transferable skills		
	Research skills		
Study skills, information	Student led seminar and laboratory	Submission of course work and case	
management including searching	classes, on-line directed study	studies for each module.	
research archives.	support.		
	Communication skills		
Scientific presentation of results	Lecturer-driven seminar classes	Submission of course work and case	
appropriate to a wider		studies for each module.	
engineering context such as a			
systems engineering one.			
A not stice I weath a defer a valuating	Data presentation	Submission of course work and coop	
Analytical methods for evaluating	classes on-line directed study	studies for each module	
systems including reviewing	support	studies for each module.	
relevant results	support.		
	Problem solving		
Ability to define and categorise.	Laboratory practical classes.	Submission of coursework.	
problems and challenges in			
construction of reliable			
embedded systems in a general			
context.			
Working relationships			
To be able to define and deliver	Student led seminar and laboratory	Assessment of group design	
the requirements, contributions,	classes.	exercises and related oral	
and limitations of a (reliable)		presentations.	
embedded system in a wider			
context.			
	Managing learning	Timely adaptivity of the second	
Research and select appropriate	Student led laboratory discussions.	i imely submission of coursework and	
architectures, techniques, and		Lase sluules.	
approaches for laboratory			
Career management			
Define and extend the use and	Project supervision meetings	Application of a variety of techniques	
role of reliable embedded		in a novel project proposal and	
systems as appropriate to an		project.	
industrial context and industrial			
projects.			

## 10. Special features:

The programme is intended to support current industrial practitioners in a CPD context. As such, modules (specifically the tools, hardware and software platforms, and techniques covered) are intentionally state-of-the-art, with teaching being very practical and hands-on, rather than focusing on core and fundamental concepts. A consequence of this is that project work (in particular) normally focusses on a specific challenge or issue facing the student in the line of their employment.

## 11. Indications of programme quality:

The programme has been included in the Engineering Department IET Accreditation submission.

## 12. Scheme of Assessment

This programme follows the Senate Regulation 6 for Taught Postgraduate Programmes. See: <u>http://www2.le.ac.uk/offices/sas2/regulations/general-regulations-for-taught-programmes</u>

Modules are assessed by coursework submission, with resit examinations where needed.

## 13. Progression points

A student is normally required to successfully complete modules EG7510, EG7520, and EG7530/EG7570 before taking modules EG7540, EG7550, and EG7560. A student will normally be expected to have reached this progression point within 12 months of commencing the course.

A student is normally required to successfully complete modules EG7510, EG7520, and EG7530/EG7570 before commencing the project proposal (EG7580). A student will normally be expected to have reached this progression point within 12 months of commencing the course.

A student is required to successfully complete the project proposal (EG7580) before commencing the project (EG7590). A student will normally be expected to have reached this progression point within 18 months of commencing the course.

A student is normally required to successfully complete modules EG7540, EG7550, and EG7560 within 24 months of commencing the course.

In cases where a student has failed to meet a requirement to progress he or she will be required to withdraw from the course and a recommendation will be made to the Board of Examiners for an intermediate award where appropriate.

### 14. Rules relating to re-sits or re-submissions:

As the taught modules are all assessed via laboratory exercises and case studies (with on-line support) re-submission is not permitted. Where necessary, the module can be re-assessed based on 100% examination.

This programme follows the Senate Regulation 6 for Taught Postgraduate Programmes. See: <u>http://www2.le.ac.uk/offices/sas2/regulations/general-regulations-for-taught-programmes</u>

# 15. Additional information [e.g. timetable for admissions]

We propose that students may enter the programme at one of 2 points: September, or April. Their active date of registration will be from the date they take their first module.

### **16. External Examiners**

The details of the External Examiner(s) for this programme and the most recent External Examiners' reports can be found <u>here</u>.

### Appendix 1: Programme structure (programme regulations)

- EG7510 (15 credits, core) Programming Techniques For Reliable Embedded Systems
- EG7520 (15 credits, core) Design and Verification of High Integrity Embedded Systems
- EG7530 (15 credits, option #1) Software Engineering for Reliable Embedded Systems
- EG7540 (15 credits, core) Using FPGAs in Reliable Embedded Systems
- EG7550 (15 credits, core) Multi-processor and multi-core designs for Reliable Embedded Systems
- EG7560 (15 credits, core) Using an RTOS in Reliable Embedded Systems
- EG7570 (15 credits, option #1) Embedded automotive systems using ISO26262
- EG7580 (30 credits, core) Project planning and pilot study
- EG7590 (60 credits, core) Project execution and reporting

# Appendix 2: Module Specifications

See module specification database http://www.le.ac.uk/sas/courses/documentation