Module Type		Taught	
Level		6	Credit Value: 10
Programme(s) in which module is available		BEng: Electrical and Electronic Engineering, .Communications Engineering, Electronic Engineering and Computer Science BSc Internet Systems, Electronic Product Design	
Involvement of Other Schools		None	
Resource Split		N/A	
Name of Module Co-ordinator		Dr DJ Holding, Dr GF Carpenter	
Related Modules	Pre-requisites	EE2DPS or equivalent	
	Co-requisites	None	
	Prohibited Combinations	None	
Minimum and Maximum Intake Sizes		None	

Aims of the Module

To provide students with an understanding of the architecture, design and evolution of a range of modern processing systems. To investigate a range of architectures, from simple microprogrammed systems to high performance RISC processors and multi-core microprocessors. To study a range of applications from networks of small ad hoc wireless sensor nodes or pervasive processors, through low-cost computers suitable for widespread deployment, to high performance embedded engineering or medical applications.

Students studying this module will learn about the principles and design of a range of modern processing systems. The module covers both high-level concepts and detailed operation and design. They will learn about the design of both general purpose and application-specific processing systems including distributed systems. An important part of the course is the series of case studies in which small groups of students will learn how to research, analyse, evaluate, and report on a range of a modern embedded microcontrollers and single or multicore processors. They will also report on a range of processor applications including environment monitoring using wireless sensor networks, low cost laptop computers for widespread deployment in the third world, high performance personal computers, and real-world applications of embedded processor architectures in areas such as communications, control systems, and medical engineering.

Summary of Content

Microprogrammable Processors: Design of simple microprogrammable architectures, microprogrammable systems design. Programmable controllers, DSP-style devices. Ad hoc wireless sensor node case study.
Processor Design: Architecture of conventional processors. Overview of datapath and controller design. RISC processor including architecture, instruction pipelines, caches, hierarchical memories. Performance modelling. Case study of a range of a modern single core CISC and RISC processors, and multicore processors.
Communicating systems: Introduction to the dynamics and behaviour of communicating systems, including synchronous and asynchronous system. Logic description of communicating sequential processes. State models (FSM's / ASM's, Statecharts, Petri nets). Behavioural analysis. Case study of a system with safety implications. Compositional synthesis of communicating systems.
Co-Design: Notion of developing a high-level software-based design, part of which will be synthesised to hardware, the other part being implemented as software executing on an embedded processor. Associated design flows, design decisions and trade-offs.
Refinement versus re-design: A quantitative approach to refinement using cost, performance and usage data. Designs as intellectual property. Parameterised designs, IP cores, fast protoyping of large scale systems.
Reconfigurable Systems: Adaptive and reconfigurable hardware systems. Product life cycle. Post deployment reconfiguration including WLAN and Internet updated systems. Application case study.

Summary of Methods and Frequency of Teaching

Lectures: 15 x 1 hour Tutorials: 5 x 1 hour Private study: 80 hours
Three Case Studies: 1: Intelligent sensor node application; 2: Comparison of processors; 3: *Either* System with safety implications *or* Reconfigurable system application

Summary of Methods of Assessment and Feedback (including formative feedback)

Continuous Assessment 100% , comprising Case study 1 (25%); Case study 2 (40%); Case study 3 (35%)
Feedback will be provided according to School guidelines. 1-to-1 feedback will be provided orally in tutorials and by written comments on written reports. Generic feedback

will be provided orally in class and via Blackboard.		
Module Outcomes – what the student should gain from successful completion of the module:	Learning and Teaching and Assessment Strategies to enable outcomes to be achieved and demonstrated	
	Learning and Teaching Methods	Assessment Methods
Knowledge and Understanding of • Fundamental concepts the architecture and design of modern application-specific and general purpose processing systems. • Design and analysis of communicating systems and knowledge of their behaviour and application including systems with safety implications. • Understanding of the product life cycle and the role of adaptive and reconfigurable (hardware) systems, including internet reconfigurable systems.	Lectures, tutorials, case studies	Continuous assessment of case studies.).
Intellectual Skills • Analyse and solve engineering problems • Evaluate and integrate information from a variety of sources • Plan, conduct, evaluate and report on a programme of work. • Design a solution to an engineering problem, subject to various constraints, evaluate that design and make improvement	Lectures, tutorials, case studies	Continuous assessment of case studies.
Professional/Subject Specific Skills • Use professional sources and documentation • Group and team working to meet specified objectives. • Prepare a technical report or presentation	Lectures, tutorials, case studies	Continuous assessment of case studies.
Transferable Skills • The ability to communicate effectively, both in writing and orally • The ability to solve problems • The ability to carry out self study • The ability to use ICT • The ability to manage time and resources • Independent learning skills to facilitate professional development	Lectures, tutorials, case studies	Continuous assessment of case studies.

Introductory Learning Resources	Module information, tutorial material and generic feedback will be available on Blackboard
Core Texts	Computer Organization and Design, Patterson, D.A. and Hennessy, J.L., 3rd Edn., Morgan Kaufmann, 2007. ISBN 978-0-12-370606-5
Reading Lists	'Computer Architecture, a Quantitative Approach', 4th Edn, Hennessy, J.L. and Patterson, D.A., Morgan Kaufmann, 2006. ISBN 978-0123704900
Specification completed by:	Geof Carpenter 23.7.09