16 School of Engineering and Digital Arts

EL822 Data Networks and the Internet

Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
3	Canterbury	Autumn	M	15 (7.5)	85% Exam, 15% Coursework	Gomes Prof N

Contact Hours

Total contact hours: 47
Private study hours: 103
Total study hours: 150

Department Checked

28/08/2018

Learning Outcomes

1.Understand the theory behind the protocols used in modern communication networks
2.Understand the operation of the most common modern protocols
3.Examine network performance through analytical methods and computer simulation

Method of Assessment

85% Examination
15% Coursework

Preliminary Reading

See http://readinglists.kent.ac.uk

Pre-requisites

None

Restrictions

None

Synopsis *

Local area networks: Ethernet technologies and standards; switched Ethernet and STP; virtual LANs; wireless LANs and WiFi. Personal area network technologies and standards for the Internet of Things: Bluetooth, ZigBee, LoWPAN.

IP Networks: IPv4 and IPv6 addressing, operation; routing protocols; Mobile IP; transport layer (TCP/UDP) and application layer protocols, including real-time protocols.

Network security and encryption mechanisms: IPSec and other security protocols. Network performance analysis, queuing theory, and network simulation.

EL827		Advanced Communication Theory				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
3	Canterbury	Autumn	M	15 (7.5)	85% Exam, 15% Coursework	Wang Prof J

Availability

Contact Hours

Total contact hours: 41
Private study hours: 109
Total study hours: 150

Department Checked

20/08/2018

Learning Outcomes

1) Understand the principles of different digital modulation schemes, spread spectrum technology, multiple access technologies, and how to analyse them;
2) Understand the principles of multichannel and multicarrier communications;
3) Understand the principles of multiple input multiple output systems;
4) Understand the principles of information theory.
5) Understand the principles of error correcting codes and be able to analyse and design in outline the digital circuits employed

Method of Assessment

85% Examination
15% Practical

Preliminary Reading

See http://readinglists.kent.ac.uk

Pre-requisites

None

Restrictions

None

Synopsis *

Advanced modulation and optimal receivers design and their performances of M-ary PSK and QAM; Signal design for bandlimited channels; Carrier and symbol synchronization; Multichannel and multicarrier communications (e.g. OFDM); Filterbank based Multicarrier Transmission (FBMC); Spread spectrum and CDMA signals for digital communications; Multiuser communications; multiple input multiple output (MIMO) technology.

EL829		Embedded Real-Time Operating Systems				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
2	Canterbury	Spring	M	15 (7.5)	60% Exam, 40% Coursework	Hossain Dr M

Availability

Contact Hours

Total contact hours: 36
Private study hours: 114
Total study hours: 150

Department Checked

25/10/2016

Learning Outcomes

1. Operating systems and their advantages to embedded systems design
2. RTOS Basic Principles
3. RTOS development tools and environments
4. Practical RTOS systems and applications
5. HW/SW Co-synthesis algorithms
6. System partitioning for HW/SW co-design
7. Special HW/SW architectures

Method of Assessment

Practical (20%)
Practical (20%)
Examination (60%)

Preliminary Reading

See http://readinglists.kent.ac.uk

Pre-requisites

None

Restrictions

None

Synopsis *

Embedded real time operating systems (rtos)

Operating Systems (OS) and Real-Time Operating Systems (RTOS). Embedded RTOS. Software development methods and tools: Run-time libraries. Writing a library. Porting kernels. Concurrent Programming and Concurrent Programming Constructs. Task Scheduling and Task Interaction. Basic Scheduling methods, scheduling algorithms. Tasks, threads and processes. Context switching. Multitasking. Communication, Synchronisation. Semaphores and critical sections. Example RTOS systems. (E.g. Embedded Linux, Windows CE, Micrium, VxWorks etc.). Programming and debugging Embedded Systems. Practical examples and case studies.

Hardware/software co-design

Embedded Processors; Hard and Soft Processor Macros (e.g. Altera Nios and Xilinx Microblaze, ARM). A brief overview of peripherals. Architectural Models. HW/SW Partitioning and partitioning algorithms. Distributed systems. Memory architectures, architectures for control-dominated systems. Architectures for data-dominated systems. Compilation techniques for embedded processor architectures. Modern embedded architectures. Architecture examples in multimedia, wireless and telecommunications. Examples of emerging architectures. Multiprocessor and multicore systems.
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EL831		Digital Visual Art set-up				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
4	Canterbury	Autumn	M	15 (7.5)	100% Coursework	Byers Brown Mr D

Availability

Contact Hours

Total contact hours: 140
Private study hours: 10
Total study hours: 150

Learning Outcomes

1. Have a thorough knowledge of the wide range of skills and procedures employed in the modelling and animation production cycle including modelling, rigging, skinning, muscle dynamics, texturing and lighting.

2. Understand the role of a digital animator in the full production cycle.

3. Understand these areas across a range of current software with hands-on ability particularly in Alias Maya and a compositing program.

Method of Assessment

Portfolio (100%)

Preliminary Reading

See http://readinglists.kent.ac.uk

Pre-requisites

None

Restrictions

None

Synopsis *

Studio Classes:
Introduction to Modelling,Animation,Lighting, Rendering, Compositing.

Coursework:
Integrated project inclusive of outcomes

Workshops:
Step by step instruction on tackling the problems.

EL832		Animation Principles				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
2	Canterbury	Autumn	M	15 (7.5)	100% Coursework	Byers Brown Mr D

Availability

Contact Hours

Contact Hours 32
Private Study 118

Department Checked

14/11/2018

Learning Outcomes

1. Have a thorough knowledge of the fundamental guiding concepts of professional animation.
2. Have applied these principles to both imagined and observed actions, and will understand how to break down and begin to construct any type of action.
3. Know and instantly recognise these principles derived from classical drawn animation and model animation, transposed into the medium of digital animation.
4. Have the conceptual tool kit to tackle animation tasks and to discuss and improve their work.

Method of Assessment

Portfolio (100%)

Preliminary Reading

See http://readinglists.kent.ac.uk

Pre-requisites

EL831 (DIGM8310) - ANIMATION SET UP

Restrictions

None

Synopsis *

Introduction to basic methods and considerations for animators

EL833		Visual Training				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
2	Canterbury	Whole Year	M	15 (7.5)	100% Coursework	Byers Brown Mr D

Availability

Contact Hours

Total contact hours: 32
Private study hours: 118
Total study hours: 150

Department Checked

20/08/2018

Learning Outcomes

1. Use diagrammatic sketches to plan out effectively 3D animation acting sequences.
2. Pre-visualise effectively the perspective, blocking, muscle deformations, posing and gestures involved in 3D character acting and action sequences.
3. Have developed a working grasp of anatomy and its potentials for movement in different types of creature.

Method of Assessment

Portfolio (100%)

Pre-requisites

EL831 (DIGM8310) - Digital Visual Art Set-Up

Restrictions

None

Synopsis *

Basic figure drawing for animation.
Basic human anatomy for animation.
Comparative anatomy for animation.

<B>Coursework:</B>
Portfolio:
An assessed portfolio of artwork created over a series of practical assignments in Workshops and Studio Classes, including drawings, sculpture, 2D and 3D sequences.

EL837 Professional Group Work

Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
4	Canterbury	Spring	M	15 (7.5)	100% Coursework	Byers Brown Mr D
4	Canterbury	Spring	M	15 (7.5)	100% Coursework	

Contact Hours

Total contact hours: 56
Private study hours: 94
Total study hours: 150

Department Checked

20/08/2018

Learning Outcomes

In the context of undertaking a group project, understand the constraints and terminology of a professional animation and visual effects environment.

Method of Assessment

Portfolio (100%)

Pre-requisites

EL831 (DIGM8310) - Digital Visual Art Set-Up

Restrictions

None

Synopsis *

This module is a group project which allows the student to work on a model of an actual animation job provided by our industrial partner. Each group produces an animation from established plates and models to a 4 week deadline. The student works with a model of a production pipeline, becoming familiar with the production process, chains of approval and departmental divisions.

EL839		Effects Animation				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
2	Canterbury	Autumn	M	15 (7.5)	100% Coursework	Byers Brown Mr D

Availability

Contact Hours

Total contact hours: 56
Private study hours: 94
Total study hours: 150

Department Checked

20/08/2018

Learning Outcomes

1. Have a fundamental knowledge of Maya's particle dynamic system;
2. Be able to create effects such as rain, steam, crowd, populated city and etc using Maya's particle system at low cost of rendering and simulating power;
3. Have a knowledge of Maya's Fluid effects and nCloth;
4. Be able to create realistic effects such as fire, explosion, smoke as well as soft and interactive material such as cloth, rubber or deforming metal.

Method of Assessment

Portfolio (100%)

Pre-requisites

EL831 (EENG8310) - Digital Visual Art Set - up

Restrictions

None

Synopsis *

<B>Particle dynamics</B>
Particle tool and particle emitters, cycle emission, volume emitters, force fields, lifespan, constraints, adding springs, soft-body dynamics, active and passive rigid bodies, setting static and dynamic friction, damping, mass, bounciness, caching, rendering in software hardware and Mentalray.

<B>Fluid Effects</B>
2d and 3d fluid containers, emitting fluids from objects and curves, colliding
fluids with objects, explosions, creating atmospheric systems, realistic fire, explosion and smoke effects, interacting fluids with particles, combustible fluids.

<B>nCloth</B>
nParticle, nConstraint, nSolver, cloth collision, collision layer, wind and gravity, nCache.

<U>Coursework</U>

Students are required to assemble a portfolio contains various dynamic instances created, simulated and rendered using Maya tools.
Assessed.

EL846 Industrial Context of Biometrics

Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
4	Canterbury	Spring	M	15 (7.5)	65% Exam, 35% Coursework	

Availability

Only available to students on programmes owned by The School of Engineering and Digital Arts

Contact Hours

Lectures 20 hours
Colloquia 10 hours
Biometric and Secure Systems 1 hour
Assignment 1 hour

150 Total study hours for the module

Department Checked

9 December 2015

Learning Outcomes

Have an understanding of the importance of standards in biometric systems and the mechanisms by which such standards are agreed.
Have an understanding of the ethical issues underlying the practical employment of biometric systems.
Gained an appreciation of the current industrial context in which biometric and secure systems are developed and employed.
Have an understanding of issues related to testing and evaluation of biometric systems.

Method of Assessment

65% of marks will be awarded for an end of module examination which will test learning outcomes 1, 2 and 4.

35% of marks will be awarded for an assignment which will test learning outcome 3. All the generic learning outcomes will be tested.

Pre-requisites

EL857 - PRACTICAL BIOMETRIC SYSTEMS

Restrictions

None

Synopsis *

<U>Lecture Syllabus</U>

<B>Standards</B>
Importance of standards and regulation; Standardisation bodies and procedures: ISO, ANSI, NIST, BSI, CEN, etc; OSI security architecture and ISO security framework; Real world security requirements in civil aviation, e commerce, etc; Standards for encryption and key management; Biometrics related standards; Guideline for secure systems management. CBEFF, BIOAPI, Data Formats.

<B>Testing & Evaluation</B>
Data collection: volunteer sampling; ethical issues; multi-session transaction; impostor data generation; Standard databases;

<B>Analysis</B>
Data visualization; Statistical analysis of experimental observations; validation of the test results;

<B>Evaluation criteria and best practices guidelines</B>
Reporting;

<B>Industrial Colloquia</B>
There will be a series of colloquia given by distinguished academics and/or speakers from industry on contemporary challenging issues.

<B>Expected topics for seminars</B>
Contemporary research & developments in security and biometrics
Challenges in industry
Government/European/Global policy on security issues
Perspectives from the law enforcement agencies
Legal, Societal and Ethical Issues

<U>Coursework</U>

<B>Assignments</B>
There will be two assessed assignments (one written and one presentation) in which students will address contemporary issues relevant to modern biometric and secure systems.

EL857		Biometric Technologies				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
4	Canterbury	Autumn	M	15 (7.5)	65% Exam, 35% Coursework	Hoque Dr S

Availability

Contact Hours

Total contact hours: 44
Private study hours: 106
Total study hours: 150

Department Checked

14/11/2018

Learning Outcomes

1. Understand, in detail, the operation of a number of practical biometric systems using a variety of modalities.
2. Design and implement biometric systems using a number of modalities.

Method of Assessment

65% Exam
35% Coursework

Pre-requisites

Restrictions

None

Synopsis *

Biometrics and biometrics systems; Biometric modalities; Components of a biometric system; Biometrics sample acquisition, transformation, & normalisation; Errors, error sources, and error handling in identification systems; Concept of multimodal systems: accuracy, flexibility, usability, inclusion and exception handling. Characterising human behaviour in biometrics-based systems. .

Implementation of biometric systems. Examples of systems using the major modalities such as face recognition, iris recognition, handwritten signature verification, fingerprint processing, etc. Analysis of modality specific techniques: segmentation, feature extraction, selection and classification strategies. State of the art in sensor technologies; Spoofing and counter-measures.

EL858		Advanced Pattern Recognition				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
6	Canterbury	Spring	M	15 (7.5)	65% Exam, 35% Coursework	

Availability

Contact Hours

Total contact hours: 39
Private study hours: 111
Total study hours: 150

Department Checked

14/11/2018

Learning Outcomes

1 Design and implement biometric systems.
2 Critically appraise alternative applications of biometrics.
3 Understand, in detail, the operation of advanced pattern classification techniques involving multi-modal systems.

Method of Assessment

65% Exam
35% Coursework

Restrictions

None

Synopsis *

Advanced Techniques for Feature Classification and Multi-Modal Systems

Analysis of Bayesian Classification; Feature selection strategies using genetic algorithms and Principal Component Analysis; Multiple classifier combination strategies. Intelligent and dynamically adaptable classification techniques; Multi-source biometric systems and score normalisation techniques.

EL870		Visual Effects Project				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
2	Canterbury	Spring	M	60 (30)	100% Coursework	Byers Brown Mr D

Availability

Only available to students on programmes owned by The School of Engineering and Digital Arts

Learning Outcomes

Be able to demonstrate unequivocal professional ability in developing a showcase show reel piece.
Gain experience of project management and professional quality document preparation.
Be able to achieve and express an intelligent and informed overview that complements and enriches the practice of professional Computer-Generated Imagery (CGI).

Pre-requisites

EL864 - PREVISUALISATION

Restrictions

None

Synopsis *

Each student uses all the experience gained on the course to produce a video short in high definition which showcases his or her professional visual effects skills and forms a suitable entree to a professional career.

The subject, script, models and soundtrack of the piece are agreed with the academic staff, or is a project from an Industrial collaborator.

EL871		Digital Signal Processing (DSP)				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
4	Canterbury	Autumn	M	15 (7.5)	60% Exam, 40% Coursework	Zhu Dr H

Availability

Contact Hours

Total contact hours: 62
Private study hours: 88
Total study hours: 150

Department Checked

14/11/2018

Learning Outcomes

1 Understand the principles of Digital Signals in both the time and frequency domains and use the Fourier Transform, the Fast Fourier Transform and the Z-Transform to analyse such signals.
2 Understand and critically appraise the effects of noise on digital systems;
3 Employ standard methods to design filters for use in processing digital signals.
4 Comprehensively understand how DSP techniques can be used in Instrumentation and Measurement, image processing (and image compression) and modern communication systems.

Method of Assessment

Exam 60%
Coursework 40%

Pre-requisites

None

Restrictions

None

Synopsis *

Signals:
Introduction to signals and signal analysis. Frequency and time domain representations of signals. A review of the Fourier Series, Fourier Transform and Laplace Transforms. Noise: definitions and sources of noise in signal analysis.

Digital Signal Processing:
The sampling theorem, Aliasing, Anti-Aliasing and Anti-Imaging Filters, ADCs and DACs. The Fourier Transform (FT). The Discrete Fourier Transform (DFT) and The Fast Fourier Transform (FFT).The Z-transform. Pole-Zero placement methods for signal analysis. Transfer functions in S and Z domains. Theory, design and performance of Finite Impulse-Response (FIR) and Infinite-Impulse-Response (IIR) Filters. Multirate DSP. Architectures and devices for digital signal processing. Effects of Finite Precision.

Applications of DSP:
Processing and filtering of signals for Instrumentation and measurement, Processing and filtering of images: DSP in modern communication systems.

EL872 Wireless Communications

Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
3	Canterbury	Spring	M	15 (7.5)	75% Exam, 25% Coursework	Wang Prof J

Availability

Only available to students on programmes owned by The School of Engineering and Digital Arts

Contact Hours

Total contact hours: 29
Private study hours: 121
Total study hours: 150

Department Checked

14/11/2018

Learning Outcomes

1) Understand the key theoretical concepts and protocols involved in the operation of broadband wireless communications;
2) Understand the key theoretical concepts of advanced technologies and architectures towards next generation wireless communications;
3) Be able to research and make realistic assessments of current technology trends;
4) Be able to research and make realistic assessments of potential technologies for future wireless networking.

Method of Assessment

Presentation (10%)
Assignment (15%)
Examination (75%)

Pre-requisites

EL827 (EENG8270) Advanced Communications Theory

Restrictions

None

Synopsis *

Overview of wireless communications; wireless channel models; capacity of wireless channels; cellular concept; handoff; adjacent cell interference; adaptive modulation; diversity; MIMO technologies, CDMA and OFDMA; radio resource allocation; third generation (3G), forth generation (4G) LTE, and fifth generation (5G) mobile communication systems;

EL873		Advanced Networking Systems and Technology				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
3	Canterbury	Spring	M	15 (7.5)	75% Exam, 25% Coursework	Gomes Prof N

Availability

Contact Hours

Total contact hours: 28
Private study hours: 122
Total study hours: 150

Department Checked

14/11/2018

Learning Outcomes

1. Understand the key theoretical concepts involved in the operation of high-speed networks;
2. Understand the key theoretical concepts involved in the operation of multimedia networks;
3. Research and make realistic assessments of current technology trends.

Method of Assessment

Assignment 1: 1000 word seminars report (15%)
Assignment 2: Case study presentation (10%)
Examination: 2hrs (75%)

Pre-requisites

EL822 (EENG8220) - Data Network and the Internet

Restrictions

None

Synopsis *

High-speed access networks: ADSL,VDSL, G.fast; PONs and point-to-point Ethernet; cable networks (DOCSIS and MoCA). Fixed wireless access. High-speed transport networks: SDH, OTN and WDM technology. Quality of Service in the Internet, and multimedia networking. Multicast routing. Differentiated services, queuing disciplines and queue management. Multi-protocol label switching. Wavelength routing and MP□S. Software-defined networking and virtualised network functions. X-as-a-Service concepts. Industry "hot-topic" seminars.

EL876 Advanced Control Systems

Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
2	Canterbury	Autumn	M	15 (7.5)	60% Exam, 40% Coursework	

Contact Hours

Total contact hours: 38
Private study hours: 112
Total study hours: 150

Department Checked

14/11/2018

Learning Outcomes

1. Have an understanding of the factors that limit the performance of feedback control systems;
2. Be able to understand the implication of digital implementation of feedback control systems;
3. Use classical feedback control methods for design and analysis;
4. Apply appropriate system analysis tools to inform the control design process;
5. Design and analyse feedback control systems using a range of techniques;
6. Be able to design and analyse control systems using state-of-the-art software in the Matlab environment

Method of Assessment

Assignment (6%)
Workshop (8%)
Assignment (12%)
Assignment (6%)
Workshop (8%)
Examination (60%)

Pre-requisites

None

Restrictions

None

Synopsis *

This course is concerned with the design of practical feedback controllers. Feedback is used in a control system to change the dynamics of the plant or process, and to reduce the sensitivity of the system to uncertainty from external signals (for example, disturbances and noise) and model uncertainty. If the performance specifications are achieved in the presence of the expected uncertainties, then the control is said to be robust.

Control Fundamentals and Modelling:
Methods for modelling engineering processes, state space representation, controllability and observability. The feedback control paradigm.

Digital Feedback Control:
Implications of digital implementation of feedback control systems. Controller Emulation Methods. Direct digital design of feedback control systems. Case study examples.

Nonlinear Control Systems:
Characteristics of nonlinear system behaviour, Phase-plane methods, Variable-structure systems and sliding-mode control. Case study examples.

EL893		Reconfigurable Architectures				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
1	Canterbury	Autumn	M	15 (7.5)	70% Exam, 30% Coursework	

Contact Hours

Total contact hours: 66
Private study hours: 84
Total study hours: 150

Department Checked

14/11/2018

Learning Outcomes

1. Systematically and comprehensively understand reconfigurable architectures including CPLD, FPGA and coarse-grained devices.
2. Design, model and verify digital systems using VHDL/Verilog and vendor specific logic synthesis tools and devices.
3. Demonstrate critical appraisal in the implementation, testing and debugging of complex digital designs on hardware
4. Comprehensively understand modern heterogeneous Programmable Systems on Chip (PSOC) architectures and devices.

Method of Assessment

Assignment (12%)
Assignment (18%)
Examination (70%)

Pre-requisites

None

Synopsis *

An Introduction to reconfigurable systems. PLDs, PLAs, FPGAs. Fine grain architectures, Coarse grain architectures, Heterogeneous device Architectures. Case studies. Configuration of FPGA's. Run-time configuration, partial configuration, dynamic reconfiguration. Partitioning systems onto a reconfigurable fabric. Synthesis tools. Timing issues. Verification and Test strategies.

An introduction to Hardware Description Languages. VHDL will be used to illustrate a typical HDL (but this may change to or include Verilog in future). The lectures will define the architectural aspects of a VHDL : entity, architecture, process, package, types, operators, libraries, hierarchy, test benches and synthesisable VHDL. Workshops and laboratories will be used to illustrate how VHDL code is synthesised on to physical hardware devices and a number of challenging practical design examples will be used to illustrate the process.

Basic computer arithmetic and its implementation on reconfigurable logic architectures. Fixed-point and Floating point number representations. The IEEE-754 FP standard. Redundant Number Systems. Residue Number Systems. Methods for Addition and Subtraction. Fast adder architectures. Multi-operand addition. Multiplication: Multiplier architectures; Constant coefficient multipliers; Distributed arithmetic; LUT methods. Special methods: division, square root, the CORDIC algorithm. High-throughput arithmetic. Low-power arithmetic.

EL894		Digital Integrated Circuit Design				
Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
1	Canterbury	Autumn	M	15 (7.5)	60% Exam, 40% Coursework	

Contact Hours

Total contact hours: 90
Private study hours: 60
Total study hours: 150

Department Checked

14/11/2018

Learning Outcomes

1) A detailed understanding of the operation of the MOS transistor and an ability to design digital circuits using CMOS technology that operate within a specified range of voltages, currents and temperatures when fabricated on an integrated circuit. An ability to use CAD tools to model and verify the operation of logic CMOS circuits.
2) A detailed practical understanding of CMOS design rules and the impact of circuit layout on circuit performance. An ability to use CAD tools to build and verify the operation of basic CMOS logic circuits. An appreciation of different circuit design techniques including full- and semi-custom methods and the use of CAD tools and their conflicting impact on device cost and designer productivity.
3) A detailed understanding of basic combinatorial and sequential logic circuits and an appreciation of the impact of different clocking strategies on circuit design and performance.
4) An understanding of CMOS memory design including ROM, PLA, Static and Dynamic RAMs and memory addressing techniques including row & column decoders. An appreciation of other volatile and non-volatile memory types such as EPROM, EEPROM, FRAM and MRAM and their current and future impact on modern fabrication technologies.
5) An understanding of Data Path components including Adders, ALUs, Registers and Multiplier Design. The ability to design, build and verify the operation a simple data-path circuit using modern CAD tools.
6) An appreciation of digital fault mechanisms and formal test strategies for circuits and chips. An understanding of formal methods for Automatic Test Pattern Generation (ATPG). A detailed understanding of the IEEE1149.1 Boundary Scan (or JTAG) Standard and its derivatives.
7) The ability to design and build a digital circuit from a system specification and evaluate its performance.

Method of Assessment

Coursework (40%)
Examination (60%)

Pre-requisites

None

Synopsis *

This module will cover the fundamental concepts of digital circuit design using CMOS technology. It begins with an overview of CMOS technology and introduces the simple and extended circuit models for NMOS and CMOS transistor devices. The module will cover transistor level design of logic gates (both combinatorial and sequential) at the device and layout level. It will include memory design (ROM, SRAM and DRAM) and memory decode logic. Static and dynamic clocking methods will be described including examples of 1-phase, 2-phase, 4-phase clocking and Domino and NORA logic techniques. The course will also cover alternative low-power logic families such as DCVS and Adiabatic Logic and discuss the implications of modern methods such as the use near- and sub-threshold logic on circuit design. Chip level design methodologies such as full-custom, semi-custom and standard cell will be explored. The course will use appropriate CAD tools (Cadence®, Synopsys®, Tanner®) and modern fabrication technologies (down to 65 nm) that are common in the design of CMOS integrated circuits to illustrate the range of techniques and methods described in the lectures. Students will use knowledge gained in lectures and workshops to develop their own IC designs in the laboratories.

EL896 Computer and Microcontroller Architectures

Version	Campus	Term(s)	Level	Credit (ECTS)	Assessment	Convenor
1	Canterbury	Autumn	M	15 (7.5)	60% Exam, 40% Coursework	Yan Prof Y

Contact Hours

Total contact hours: 76
Private study hours: 74
Total study hours: 150

Department Checked

14/11/2018

Learning Outcomes

1) Systematically and comprehensively understand of fundamental computer architectures and the basic building blocks (i.e. ALU, CPU, Registers, Program and Data memory) used to build them.
2) Appreciate and critically appraise alternative processor architectures such as RISC, CISC, VLIW, SIMD, MIMD and DSP. Application Specific Signal Processing (ASSP) and Multi-Core Processors.
3) Comprehensively understand the structure of a typical microcontroller and associated peripherals. An ability to make an informed decision about the choice of microcontroller for a particular application(s).
4) Compile and download code onto a microcontroller using commercial Integrated Development Environments
5) Systematically and comprehensively understand Microcontroller Peripherals: ADCs and DACs, Timers and Input Capture. Communication using the IIC, SPI, UART, Displays. Interrupts and Interrupt Service Routines.
6) Program microcontrollers using C and C++ Programming.
7) Critically appraise software development and Software testing techniques.

Method of Assessment

Workshop (10%)
Workshop (5%)
Workshop (5%)
Workshop (5%)
Workshop (5%)
Workshop (10%)
Examination (60%)

Pre-requisites

None

Synopsis *

This module focuses on the basic principles of modern computer architecture and how they are mapped onto modern (32-bit) microcontrollers. The course uses the ARM processor core as an exemplar of a modern processor architecture that is now ubiquitous in embedded systems. The course will cover classic topics in architecture (CPU and ALU structure, Instruction sets, memory and memory) and performance metrics for evaluating the relative performance of different architectures such as RISC vs CISC and also VLIW, SIMD, MIMD, ASSP and DSP devices.

The NXP 1786 (mbed) microcontroller is used as an example microcontroller development platform and industry standard IDE's from Keil/IAR are used to program, test and debug them. The course includes a comprehensive presentation of typical microcontroller peripherals: ADCs and DACs, Timers and Input Capture, communication using IIC, SPI, UART. Displays. Interrupts and Interrupt Service Routines (ISRs).

The course also provides an introduction to the C and C++ programming languages and their use with microcontroller based systems. This material will include: Variables, data-types and arithmetic expressions. Strings, Loops, Arrays. Functions, Structures, Pointers, bit operators. The pre-processor. I/O operations in C. Debugging Programs. Object-Oriented Programming. The Standard C Library.

Issues such as software testing and testing strategies are discussed. Compiling and downloading code onto the mbed using commercial Integrated Development Environments such as Keil® and IAR®. GNU based toolchains for Microcontroller development.