

UNIVERSITY COLLEGE CORK

**Department of
Computer Science**

BSc in Computer Science
(CK401)

2004-2005

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DEPARTMENT OF COMPUTER SCIENCE

University College Cork has a very important place in the history of Information Technology – Boolean algebra, which provides the mathematical basis for computer design, was named after George Boole, the first Professor of Mathematics here. Today, the Department of Computer Science is one of the largest academic departments in UCC, with 30 academic staff and 1000 students at undergraduate and postgraduate level. Degrees at BSc, MSc and PhD levels are offered. The current Head of Department is Professor Cormac J. Sreenan, formerly a Principal Research Scientist with AT&T Bell Labs in the USA.

COMPUTER SCIENCE DEGREES

The Department of Computer Science offers a four-year undergraduate programme leading to the BSc in Computer Science. No computing experience or familiarity with computers is required or expected prior to enrolment. The programme's goal is to impart to its graduates both the fundamental scientific principles that underpin the key computing technologies in use today and the engineering skills that enable those principles to be applied in practice. Upon graduation, students should be equipped to pursue a career as computer professionals or, if they so wish, to pursue further studies.

The curriculum covers both the hardware technologies that underlie modern computer systems, and the software systems and technologies that form the basis for modern computer applications. A major emphasis of the programme is *software development*, the process by which a piece of software is developed to meet a specific technological need according to rigorous engineering principles.

This skill is developed in a series of modules incorporating significant hands-on work in supervised laboratory sessions.

In later years of the programme, specialised modules are offered on topics such as networks, computer architecture, distributed systems, multimedia, artificial intelligence, e-commerce, computer security and graphics among others.

The programme incorporates a six-month period of work experience within the IT industry during the third year and is rounded off with a substantial project completed during the final year.

Apart from the "pure computing" degrees described above (Single Honours degrees), it is also possible to combine Computer Science with another subject leading to a Joint Honours degree. This option involves roughly half the amount of Computer Science material as the Single Honours degree with the difference being made up by modules of the other subject. Currently, this option is available for economics: Business Economics and Financial Economics. The choice of whether to pursue a Joint Honours or a Single Honours degree is made at the end of first year.

Many graduates opt to undergo further studies to further enhance their skills. UCC offers specialized masters degrees in computer networks and in multimedia technology, as well as higher degrees by research. Recent government initiatives to invest significant sums in Ireland's research infrastructure should ensure excellent research opportunities for talented Computer Science graduates in the years ahead.

Details of our Undergraduate and Postgraduate Courses are available in the College Calendar.

Authoritative source of individual modules is College's [Book of Modules](#).

FIRST YEAR

BSc SINGLE HONOURS Core Modules (50 credits) CS1100, CS1101, CS1102, MA1015 Elective Modules (10 credits) EC1101, EC1206, MA1003, MA1051, MG1003, MG1004, LC0002, LC0028, LC0502, LC0521	Computer Science (40 credits) Mathematics (10 credits) plus 10 credits from one of the following: Economics or Management or Mathematics or a Language
BSc JOINT HONOURS Core Modules (50 credits) CS1100, CS1101, CS1102, MA1015 Elective Modules (10 credits) EC1101, EC1206	Computer Science (40 credits) Mathematics (10 credits) plus 10 credits from one of the following streams: Financial Economics or Business Economics

CS1100 Introduction to Programming

Credit Weighting: 20

Module Objective: Students should learn the fundamentals of object-based programs. They should learn how to design, implement and test programs for solving simple problems; and they should learn the principles of good coding style.

Module Content: Objects, message passing, classes, methods, primitive data types; expressions; assignment, parameters, local variables, instance variables, constructors, control structures, recursion, Abstract Data Types (stacks, queues, lists), arrays, simple file and interactive I/O, simple exception handling. Attention throughout to problem-solving, program-design, and testing skills.

CS1101 Systems Organisation

Credit Weighting: 10

Module Objective: Students will attain competence in a number of computing environments, operating systems and software tools; they will obtain an appreciation for computer organisation and hardware-software interaction.

Module Content: Boolean algebra, gates and elementary digital logic. System architecture, CPU, memory and input-output devices. Data representation, ones-complement, two's-complement and floating-point numbers. Instruction sets, address modes, traps, basic machine/assembly programming and language translation. Introduction to operating systems, file systems and devices.

CS1102 Internet Computing

Credit Weighting: 10

Module Objective: Students should learn the fundamentals of client-server architectures; They should learn the principles that underlie the main Internet applications; and they should learn how to author web pages, including ones that execute client-side scripts.

Module Content: Introduction to the Internet. Internet applications. Introduction to the World-Wide Web; HTTP; HTML; the XHTML-compatible dialect of HTML; cascading style-sheets; XML. HCI aspects of web-page design. Web-page development tools. Interactivity on the web: scripting languages; the role of applets.

MA1003 Introductory Mathematics and Applied Mathematics

Credit Weighting: 10

Module Objective: To introduce the fundamental mathematical techniques of science.

Module Content: Revision of trigonometry and standard functions. Co-ordinate geometry of lines, circles etc. Series. Solutions of equations, complex numbers. Basic techniques and applications of differentiation and integration. Solution of elementary differential equations associated with mathematical modelling. Construction and implementation of mathematical models. Introduction to numerical approximation, including numerical integration and curve fitting to data.

MA1015 Discrete Mathematics for Computer Science

Credit Weighting: 10

Module Objective: To provide an introduction to fundamental mathematical techniques for Computer Science.

Module Content: Elementary properties of integers. Principle of induction, divisibility. Fundamental principles of counting, permutations and combinations. Binomial Theorem. Recurrence relations. Sets, relations, functions. Introduction to mathematical aspects of programming and computing. Predicate Calculus.

MA1051 Calculus and Linear Algebra

Credit Weighting: 10

Module Objective: To provide an introduction to concepts and techniques of calculus and linear algebra.

Module Content: Differential and integral calculus. Differentiation and integration of functions of a single variable, approximations. Linear algebra, matrices, determinants, linear equations.

EC1101 Principles of Economics

Credit Weighting: 10

Module Objective: To develop and practise the economic method of reasoning.

Module Content: Theory and applied theory of the market process and exchange. Relative prices of goods and factors of production and the allocation of resources and distribution of product under various types of market structure. Production, employment and income in a monetary economy, including money, exchange rate, balance of payments, inflation and unemployment. Development of resources and growth of income.

EC1206 Principles of Economic Analysis

Credit Weighting: 10

Module Objective: To develop an understanding of the methods of economic reasoning in the business context.

Module Content: Theory and applied theory of relative prices and the distribution of resources and product under different types of market structures and firm behaviour. Theory and applied theory of production, employment and income in the monetary economy, including money, the interest rate, the exchange rate, balance of payments, inflation and unemployment.

MG1003 Introduction to Marketing

Credit Weighting: 5

Module Objective: To introduce students to the principles of Marketing.

Module Content: Introduction to the marketing concept; the history of marketing; the role of the marketing manager; the marketing mix.

MG1004 Introduction to Management and Organisation

Credit Weighting: 5

Module Objective: To introduce students to the nature and process of management and the challenges facing organizations and their leaders in today's competitive business environment.

Module Content: Topics include: the history and evolution of management thought and practice, organisation structure and design, managerial roles and functions, managing in the context of current business problems and opportunities.

LC0002 German Language (Beginner [00] Level)

Credit Weighting: 10

Module Objective: To improve a student's skill in German by one level on the language ability scale.

Module Content: A four-skills (reading, writing, speaking, listening) language course with a generally communicative approach.

LC0028 Spanish Language (Beginner [00] Level)

Credit Weighting: 10

Module Objective: To improve a student's skill in Spanish by one level on the language ability scale.

Module Content: A four-skills (reading, writing, speaking, listening) language course with a generally communicative approach.

LC0502 German Language (Intermediate [05] Level)

Credit Weighting: 10

Pre-requisite(s): Grade C or higher in Higher Leaving Certificate German, or evidence of equivalent standard

Module Objective: To improve a student's skill in German by one level on the language ability scale.

Module Content: A four-skills (reading, writing, speaking, listening) language course with a generally communicative approach.

LC0521 French Language (Intermediate [05] Level)

Credit Weighting: 10

Pre-requisite(s): Grade C or higher in Higher Leaving Certificate French, or evidence of equivalent standard .

Module Objective: To improve a student's skill in French by one level on the language ability scale.

Module Content: A four-skills (reading, writing, speaking, listening) language course with a generally communicative approach.

SECOND YEAR

<p>BSc SINGLE HONOURS</p> <p>Computer Science (50 credits)</p> <p>Core Modules CS2200, CS2201, CS2202, CS2203, CS2204</p> <p>Electives Modules (10 credits) CS2205, EC2103, MG2000, MG3000, LC0102, LC0128, LC0602, LC0621</p>	<p>Software Development; Data Structures; Enterprise Software; Operating Systems Architecture and Programming; Network Computing</p> <p>And 10 credits from the following: Theory of Computation; Economic Data Collection and Analysis; Operations Management; Enterprise Management; French; German; Spanish</p>
<p>BSc JOINT HONOURS</p> <p>Computer Science (30 credits)</p> <p>Core Modules CS2200, CS2202, CS2203</p> <p>Economics (30 credits)</p> <p>Elective Modules EC1204, EC2202, EC2207 Or EC2101, EC2102, EC2103</p>	<p>Software Development; Enterprise Software; Operating Systems Architecture and Programming</p> <p>Modules chosen from of the following streams: Financial Economics or Business Economics</p>

CS2200 Software Development

Credit Weighting: 10

Pre-requisite(s): CS1100

Module Objective: Students should learn advanced object-oriented programming language constructs; they should learn some of the principles of good object-oriented design; they should learn how to write event-driven programs for the construction of simple graphical user interfaces and other programs; and they should become acquainted with techniques for dealing with concurrency and the problems it causes.

Module Content: Recap on the main elements of class definitions; procedural abstraction and data abstraction; associations between objects; class hierarchies and inheritance; polymorphism and dynamic method binding; event-driven programming; the architecture of programs with GUIs; other uses of event-driven programming; concurrency examples and issues (processes, mutual exclusion, deadlock, starvation, interference, communication); solutions using shared memory and using message passing (e.g. semaphors, monitors).

CS2201 Data Structures

Credit Weighting: 10

Pre-requisite(s): CS1100, MA1015

Module Objective: Students should gain expertise in the interface and implementation of common data-structures, and their use in the creation of efficient algorithms.

Module Content: Review of simple linear Abstract Data Types (ADTs) from CS1100; elementary introduction to computational complexity; array-based and linked implementations of the above ADTs; hash tables: interface and implementation; trees, binary trees, binary search trees: interfaces and implementations; iterative and recursive algorithms on binary trees; overview of balanced trees; divide-and-conquer as a design strategy; quadratic and $n \log(n)$ sorting algorithms; undirected and directed graphs; graph algorithms: depth-first and breadth-first search, shortest paths, minimum spanning trees; experimental analysis of algorithm efficiency.

CS2202 Enterprise Software

Credit Weighting: 10

Pre-requisite(s): CS1100

Module Objective: Students should appreciate the problems involved in building systems that have persistent data and some of the solutions to these problems; they should learn how to query, update and administer a relational database using SQL and how to write programs that interface to databases; they should learn how to analyse business data requirements and how to design and implement databases and object-oriented software to meet those requirements.

Module Content: Persistence: files versus databases; Database Management Systems; DBMS storage structures. The relational data model: relational algebra and relational calculus; SQL; query optimisation; views; 4GLs; embedding SQL queries in procedural languages (e.g. JDBC). Database Design: UML Class Diagrams & Entity-Relationship Diagrams; UML Sequence Diagrams; conceptual, logical & physical database design; data integrity; functional dependencies & normal forms. Software development process.

CS2203 Operating Systems Architecture and Programming

Credit Weighting: 10

Pre-requisite(s): CS1100, CS1101

Module Objective: Students will learn about process and instruction execution and management in modern operating systems; and they will learn about systems programming in C.

Module Content: Programming in C. Data and programming structures in C. Memory management and pointer manipulation. The C pre-processor. Conditional compilation. Large-scale application organization. Libraries. Makefiles. Devices, files and IO. Operating Systems from an architectural perspective. Processes and resources. Scheduling. Device organisation and management. Memory management. Interrupts. User/system state transitions. Interprocess communication and synchronisation. Operating system threads. File system implementation. IO Systems. Protection mechanisms. Operating system APIs. Case studies.

CS2204 Network Computing

Credit Weighting: 10

Pre-requisite(s): CS1100, CS1101, CS1102

Module Objective: Students will learn about the fundamentals of network computing; and they will learn some basic network programming.

Module Content: Networking basics: architecture, performance, circuit/packet switching. Application layer protocols, including HTTP. Naming, including domain name system. Socket programming. Transport protocols, including TCP. Network layer: naming and routing. Internet Protocol version 6. Multicast. Link layer. Network management. Firewalls.

CS2205 Theory of Computation

Credit Weighting: 10

Pre-requisite(s): MA1015

Module Objective: Students will learn the principles of algorithm design, algorithm complexity and the theory of computation

Module Content: Computability analysis: introduction to computability and its limits, computability, halting problem. Correctness analysis: Hoare axioms, pre and post conditions, invariants, inductive proofs for recursive programs. Efficiency analysis: Big O notation, worst and average case analysis of algorithms (sorting/searching), complexity measures. NP, P. Limits of efficiency analysis, speed up.

MG2000 Operations Management

Credit Weighting: 5

Module Objective: To introduce students to Operations Management.

Module Content: Nature and history of operations management; materials management; world class operations; process design; capacity planning; forecasting; quality.

MG3000 Enterprise Management

Credit Weighting: 5

Module Objective: To introduce students to concepts of enterprise creation and growth.

Module Content: Topics include: emerging trends in developed economies; the role of small business; new

managerialism and entrepreneurial models; the boundary-less organisation.

EC1204 Economic Data Collection and Analysis

Credit Weighting: 10

Module Objective: To acquire the data collection and analysis skills and techniques required for economic analysis and examining economic theory.

Module Content: Types of economic data and their uses. Collection, organisation and storage of economic data for research, business decision-making and public policy. Approaches to presenting and analysing economic data. Place and application of basic data analysis techniques and related computer software which are standard in economic analysis. Critical evaluation of the quality and usefulness of the main sources and types of economic data.

EC2101 Theory and Applied Theory I

Credit Weighting: 10

Module Objective: To understand and practise the use of microeconomics in the context of business and public policy.

Module Content: Consumer and producer behaviour at the level of individual units under different market structures. Risk, uncertainty, time and information in decision-making. Factor markets. Trade, tariffs and industry location. General equilibrium and welfare economics. Market and corporate boundaries. Corporate control and performance.

EC2102 Theory and Applied Theory II

Credit Weighting: 10

Module Objective: To understand the relationship between business, government and the macroeconomic environment.

Module Content: Determination of the level and growth of aggregate income, demand, output and employment. Components of aggregate demand (e.g. consumption, investment) and aggregate supply. Fiscal, monetary and exchange rate policies. Money and other financial assets in the economic system. Implications of European Monetary Union.

EC2103 Economic Data Collection and Analysis

Credit Weighting: 10

Module Objective: To introduce and practise the data collection and analysis skills used in economic analysis.

Module Content: Types of economic data and their uses. Collection, organisation, storage and presentation of economic data for research, business decision-making and public policy. Basic survey techniques. Approaches to presenting and analysing economic data. Principles and uses of descriptive statistics, including basic regression techniques. Application of data analysis techniques and computer programmes which are standard in economic analysis.

EC2202 Microeconomics for Business

Credit Weighting: 10

Module Objective: To examine the competitive market process, nature of the firm, and role of the firm in the market process.

Module Content: The competitive market process. Entrepreneurship and the firm. The business plan and the firm's budgets. Risk and uncertainty in decision-making. Concepts of demand, supply and equilibrium. Demand and revenue functions. Production, technology and cost analysis. The profit motive. Market structures and the functioning of product markets and resource markets. Markets and corporate boundaries. Corporate control and corporate performance. Industry structure and competition analysis.

EC2207 The Macroeconomic Environment

Credit Weighting: 10

Module Objective: To discover the impact of government policy on the macroeconomic business environment.

Module Content: Analysis of the national and international economic framework in which business functions. Money, financial markets, interest rates and exchange rates. Impact of government on business conditions and

overall economic activity. Macroeconomic determinants of industrial competitiveness and national competitive advantage.

LC0102 German Language (Improver [01] Level)

Credit Weighting: 10

Pre-requisite(s): LC0002, or equivalent

Module Objective: To improve a student's skill in German by one level on the language ability scale.

Module Content: A four-skills (reading, writing, speaking, listening) language course with a generally communicative approach.

LC0128 Spanish Language (Improver [01] Level)

Credit Weighting: 10

Pre-requisite(s): LC0028 or equivalent standard

Module Objective: To improve a student's skill in Spanish by one level on the language ability scale.

Module Content: A four-skills (reading, writing, speaking, listening) language course with a generally communicative approach.

LC0602 German Language (Upper Intermediate [06] Level)

Credit Weighting: 10

Pre-requisite(s): LC0502, or equivalent

Module Objective: To improve a student's skill in German by one level on the language ability scale.

Module Content: A four-skills (reading, writing, speaking, listening) language course with a generally communicative approach.

LC0621 French Language (Upper Intermediate [06] Level)

Credit Weighting: 10

Pre-requisite(s): LC0521, or equivalent

Module Objective: To improve a student's skill in French by one level on the language ability scale.

Module Content: A four-skills (reading, writing, speaking, listening) language course with a generally communicative approach.

THIRD YEAR

<p>BSc SINGLE HONOURS Computer Science (60 credits)</p> <p>Core Modules CS3300, CS3305, CS3306, CS3310</p> <p>Elective Modules CS3311, CS3312, CS3313, CS3314, CS3315, CS3316</p>	<p>Work Placement; Team Software Project; Workplace Technology & Skills; Software Project Planning</p> <p>And 25 credits from the following: Middleware; Multimedia Technology; Algorithms; Web Programming; Introduction to Artificial Intelligence; Logic Design</p>
<p>BSc JOINT HONOURS</p> <p>Computer Science (35 credits) Core Modules CS3300, CS3305, CS3310</p> <p>Elective Modules CS3312, CS3314, CS3315</p> <p>Economics (25 credits) EC3206, EC3405</p>	<p>Work Placement; Team Software Project; Software Project Planning</p> <p>And 10 credits from the following: Multimedia Technology; Web Programming; Introduction to Artificial Intelligence</p> <p>Survey Methods; Game Theory and Decision Making</p>

CS3300 Work Placement

Credit Weighting: 10

Module Objective: Students should gain experience of the workplace.

Module Content: At the end of the second term, each student will take up a placement outside the Department of Computer Science on an agreed work programme. The placement period will normally be 22 weeks. The work programme will be jointly monitored by a UCC Computer Science staff member and an employee of the placement organization. Each student will be required to submit a report.

CS3301 Work Placement (12-month)

CS3305 Team Software Project

Credit Weighting: 10

Pre-requisite(s): CS2200, CS2202, CS2203

Module Objective: Students should learn the value of, and the problems associated with, working in teams, especially in the case of the development of large software systems. They should appreciate the problems associated with developing large software systems, and techniques that can overcome some of these problems.

Module Content: Students work together in formal groups to build large software systems. Lectures, seminars and workshops will provide specific project support covering such topics as: working in groups, project management and planning, analysis and design, configuration management, version control, verification and validation, project documentation.

CS3306 Workplace Technology & Skills

Credit Weighting: 10

Pre-requisite(s): CS2203

Module Objective: Students should learn workplace skills including commonplace technologies that they might encounter in their Work Placement.

Module Content: Module content will vary from year to year depending on the availability of invited speakers and

on what the Department considers to be industrially-prevalent technology. Indicative content is: C++, Visual C++, Windows architecture and programming; Systems administration: Operating Systems from the Administrator's perspective; User accounts; Security Administration; Accounting; File systems; Monitoring and managing system resources; Performance; Automating tasks with scripts; Terminal, modem, printer management; Managing mail; network, web and other application services; Unix and Windows administration case studies.

CS3310 Software Project Planning

Credit Weighting: 5

Pre-requisite(s): CS2200, CS2202

Module Objective: Students should learn the elements of software project planning; students should learn the characteristics of high quality object-oriented designs.

Module Content: Project management planning; configuration management; testing techniques. Object-oriented design: cohesion and coupling; programming to an interface; defensive programming; design patterns.

CS3311 Middleware

Credit Weighting: 5

Pre-requisite(s): CS2203, CS2204

Module Objective: Students will learn the role of middleware and different models of middleware; They will learn how to program systems that use the different models of middleware.

Module Content: Middleware Architecture. Network services and protocols. Distributed message passing. Client-server communication: RPC. Interfaces. Interface Definition Languages. Document-based middleware: the World Wide Web. Filesystem based middleware: transfer model, directory hierarchy, naming transparency, file-sharing semantics. Shared Object-based Middleware: Communication between distributed objects, RMI. Coordination-based Middleware: Events and notifications, Publish/subscribe.

CS3312 Multimedia Technology

Credit Weighting: 5

Module Objective: Students should obtain an understanding of the underlying hardware/software technologies which are essential for multimedia development.

Module Content: Theory: characteristics of analog and digital signals; conversion; Hardware: graphics cards/monitors; sound cards; video cards. Storage devices/formats: CD; DVD; DAT; Interfaces: MIDI; DV; USB; IDE/ATA; SCSI. Audio file formats and compression: WAV; MIDI; MOD; MPEG; AU; ADPCM.

CS3313 Algorithms

Credit Weighting: 5

Pre-requisite(s): CS2201

Module Objective: Students should appreciate the principles of algorithm design; They should analyse a number of classical algorithms.

Module Content: Techniques for the design and analysis of algorithms. In-depth study of worst-case and average-case analysis techniques. Case studies which may include: sorting and searching; divide and conquer algorithms; dynamic programming; Huffman codes and file compression.

CS3314 Web Programming

Credit Weighting: 5

Pre-requisite(s): CS1102, CS2200

Module Objective: Students should learn how to write programs using a variety of web technologies; Students should learn how these technologies can be deployed in e-commerce and m-commerce applications.

Module Content: The web as an example of client-server computing: Web technologies; characteristics of web servers; role of client computers; nature of the client-server relationship; web protocols; Building web applications: CGI, PERL, database-driven web sites; PHP. Extensible technologies (XHTML, XML, XML DTDs, XML schemata, XSLT, XSL FO, Xpath, Xlink, etc.)

CS3315 Introduction to Artificial Intelligence

Credit Weighting: 5

Pre-requisite(s): MA1015

Module Objective: Students should obtain a broad overview of modern AI (including a sense of its successes & failures; a sense of what is easy to do and difficult to do; a sense of its theory and its applications; and a sense of where it is heading).

Module Content: Search (uninformed and informed search); knowledge representation and reasoning; AI planning; genetic algorithms; neural networks.

CS3316 Logic Design

Credit Weighting: 5

Pre-requisite(s): CS1101

Module Objective: Students should learn the ideas that underlie the design of digital circuits.

Module Content: Combinational circuits: design and optimization; Sequential circuits: design and optimization; description languages; CAD.

EC3206 Survey Methods

Credit Weighting: 15

Module Objective: To understand and apply research and data analysis skills required in conducting business economic and financial surveys.

Module Content: Examines theoretical principles and practice of survey research methods in finance. Areas addressed include the development, design and implementation of financial economic surveys including research design, survey sampling, questionnaire design, data collection, statistical techniques for data analysis, survey reporting and survey errors and ethics. Focus will be on providing a practical grounding in the preparation, conduct and reporting of surveys for business purposes.

EC3405 - Game Theory and Decision Making

Credit Weighting: 10

Module Objective: To understand and apply the concepts of mathematical economics to the fields of business economics.

Module Content: Strategic And Extensive Forms of a Game, Information Sets, Two Person Games, Mixed Strategies, Mixed Strategy Equilibrium, Dynamic Games, Non Co-Operative Games, Risk And Uncertainty, Using Information Strategically, Moral Hazard, Adverse Selection, Signalling, Screening, The Bargaining Problem, Creating Incentives, Designing Contracts, Auctions, Interactive Decision Theory, Experimental Economics.

FOURTH YEAR

BSc SINGLE HONOURS Computer Science/Management Computer Science Project	(45 credits) (15 credits)
BSc JOINT HONOURS Computer Science Economics Project in either Computer Science or Economics	(20 or 25 credits) (20 or 25 credits) (15 credits)

CS4000 Software Engineering

Credit Weighting: 10

Pre-requisite(s): CS3000

Module Objective: To teach the fundamental concepts of software engineering as well as the techniques and tools used for software development.

Module Content: The software design process. Measuring software design quality. Abstraction, encapsulation and software design. Requirements analysis. Software Design representation: formal and informal. Executable and non-executable design representations. Software design methods: data flow, data structure, process, and object-driven approaches. Software design methods and implementation practice. Computer aided software engineering. Building integrity into system designs. Software quality assurance. Software Metrics. Parnas module interface specifications. Introduction to formal design techniques and the software design process. Specifying formal requirements: model oriented and algebraic.

CS4001 Functional and Logic Programming

Credit Weighting: 10

Pre-requisite(s): CS2000; CS2010

Module Objective: To teach students advanced declarative programming.

Module Content: Functional programming in Haskell: lazy evaluation and infinite data structures, higher order functions, algebraic data types, type classes. Logic Programming in Prolog: facts and rules, goals, Horn clauses, backtracking, cut, negation by failure, resolution and unification. Recursion; equational reasoning; operational vs. declarative semantics; program transformation; styles of declarative I/O; meta programming.

CS4010 Algorithms and Applications

Credit Weighting: 5

Pre-requisite(s): CS3010

Module Objective: To introduce the fundamentals of parallel algorithms.

Module Content: Review of algorithmic techniques underlying common software tools. Techniques for the analytical and empirical evaluation of algorithms and data structures. Principles of algorithm engineering. Application-oriented study of fundamental combinatorial and geometric algorithms. Case Studies.

CS4011 Systems Design using Formal Methods

Credit Weighting: 5

Pre-requisite(s): CS2010; CS3020; CS3030

Module Objective: To provide an introduction to the use of formal techniques in system design.

Module Content: Specification revisited: types, sets, relations functions, propositional and predicate calculus. Specifying and reasoning about abstract data types. Algebraic and model-oriented specification of systems. Pre- and post- conditions. Data and operational refinement. Verification tools.

CS4020 Distributed Systems

Credit Weighting: 5

Pre-requisite(s): CS3020

Module Objective: To study the principles of distributed systems.

Module Content: Theory, mutual exclusion, deadlock, reaching agreement.

CS4030 Microprocessor Systems Design

Credit Weighting: 10

Pre-requisite(s): CS2030

Module Objective: To teach how to design Microprocessor based Digital Systems

Module Content: Interfacing memory and paralleled I/O using SSI/MSI parts to a processor. Design of parallel and serial I/O subsystems using LSI Programmable Peripheral Interface (PPI) chips including multi-level interrupts. Memory Systems Design. Bus and I/O design for large systems. Real-time embedded systems design. Laboratory sessions involving case study designs.

CS4031 Computer Architecture

Credit Weighting: 5

Module Objective: To learn the principles of Computer Architecture and Design.

Module Content: Instruction Set Design. Case study design of the control unit and datapath of a pipeline RISC processor. Memory Hierarchy Design. Bus architecture and interconnection strategies. Tools and techniques for performance measurement. Comparison of architectures of recent processors.

CS4032 Parallel Processing

Credit Weighting: 5

Pre-requisite(s): CS2020

Module Objective: To understand algorithmic, architectural and systems aspects of parallel processing to enable implementation of appropriate solutions on available computing platforms.

Module Content: Paradigms and models for parallel computing. Parallel programming with MPI. Methods to develop parallel programs. Fundamental parallel algorithms: numerical, sorting, search and graphs.

CS4033 Non-traditional Parallel Computing

Credit Weighting: 5

Module Objective: To survey non-traditional parallel computing paradigms and architectures.

Module Content: Survey of non-traditional Parallel Computer Architectures: Taxonomy and Network topologies. Dataflow and Data-driven machines: Dataflow concepts, Manchester machine, Irvine machine, MIT machine. Static vs. Dynamic machine models. Fault Tolerance in data-driven systems. Survey of non-traditional programming paradigms and the machines which support them. Concepts and lessons: Speculation, Load-balancing, Throttling, Communication-processing ratio, Locality of execution, Granularity of computation.

CS4034 Embedded Systems Design

Credit Weighting: 5

Module Objective: To introduce the principles of embedded computer systems design.

Module Content: Embedded systems design process: modelling languages and design techniques, real time embedded systems developments, environments and platforms. Distributed embedded architectures: Networks for embedded systems. Integrating embedded systems into networked environments. Integration of networked protocols into embedded applications. Internet enabled systems.

CS4040 Information Retrieval and Organisation

Credit Weighting: 10

Pre-requisite(s): CS2000, CS2010, CS2040

Module Objective: To examine fundamental concepts of information retrieval, filtering and categorisation.

Module Content: Information Processing Strategies: Retrieval, Filtering, Extraction, and Classification. Text Retrieval. Historical Perspective. Text Retrieval Models: Boolean, Statistical, and Linguistic. Text Analysis: Lexical Analysis, Stopword Removal, Stemming, and Word Sense Disambiguation. Knowledge Representation for Text Retrieval: Document Indexing, Vector Space Model, Semantic Networks, Neural Networks, Memory-Based Reasoning. Query/Document Matching Functions. Evaluation: Precision/Recall Measures. Machine Learning in Information Management: Relevance Feedback, Term Reweighting, and Collaborative Processing. Natural Language Analysis: Semantics, Discourse, and Pragmatics. Multimedia Information Organisation: Methodologies, Standards, and Limitations. Applications: Email, USENET News, World-Wide Web, Electronic Libraries. Architectures: Robots, Spiders, Search Engines, and Agents.

CS4052 Media Authoring

Credit Weighting: 5

Pre-requisite(s): CS2050

Co-requisite(s): CS3050

Module Objective: To create a multimedia presentation using one of a number of delivery systems.

Module Content: Creation of a multimedia presentation using one of a number of delivery systems, for example an interactive website with streaming technologies or an interactive CD-ROM.

CS4054 Virtual Reality

Credit Weighting: 10

Pre-requisite(s): CS3050

Module Objective: Incorporation of different technologies.

Module Content: This module will incorporate technologies from different computing disciplines and will involve a degree of research by students. Topics for this module may include: Sensory Information; Tactile interfaces;

Forced Feedback Devices; General Immersive Technologies.

CS4061 Constraint Based Systems

Credit Weighting: 5

Module Objective: To give an understanding of Constraint Paradigm.

Module Content: Constraint satisfaction; search; consistency processing.

CS4071 Artificial Intelligence

Credit Weighting: 10

Module Objective: To convey the state of the art in Artificial Intelligence (A.I.) Systems Construction.

Module Content: Search, Logic, Knowledge Representation, A.I. Planning, Machine Learning.

CS4091 Very Large Scale Integration

Credit Weighting: 5

Module Objective: To provide an introduction to VLSI Design.

Module Content: VLSI technology. Design languages. Automated design techniques.

CS4092 Special Topics in Computing I

Credit Weighting: 5

Module Objective: To provide students with an in-depth knowledge of a selected topic related to any area of computing.

Module Content: An advanced topic selected mainly from areas within general computing science. Current members of staff and visitors to the Department of Computer Science will determine choice of topic in a given year. Students should check with the Department of Computer Science to determine what topics will be offered during a specific year and which prerequisites, if any, are appropriate.

CS4093 Special Topics in Computing II

Credit Weighting: 5

Module Objective: To provide students with an in-depth knowledge of a selected topic related to any area of computing.

Module Content: An advanced topic selected mainly from areas within general computing science. Current members of staff and visitors to the Department of Computer Science will determine choice of topic in a given year. Students should check with the Department of Computer Science to determine what topics will be offered during a specific year and which prerequisites, if any, are appropriate.

CS4094 Computer Graphics

Credit Weighting: 5

Module Objective: To learn the rudiments and gain an appreciation of the far-ranging applications of computer graphics.

Module Content: Raster scanning, pixels, line drawing. Pixel-level software. Windows and viewports, clipping.

Transformations, matrix representations. Projections. Hidden line removal. Curves and spline approximations. Colour models.

CS4150 Principles of Compilation

Credit Weighting: 5

Pre-requisite(s): CS2010

Module Objective: To develop an understanding of the Principles of Compilation.

Module Content: Lexical analysis. Syntax analysis. Symbol tables. Run-time storage management. Code generation. Compiler generation tools.

CS4153 Foundations of Computer Security

Credit Weighting: 5

Pre-requisite(s): CS1020; CS2010; CS2020

Module Objective: To introduce some of the important concepts in Computer Security.

Module Content: Secrecy, integrity and authentication. Access control models and the theory of safe systems. Multilevel security. Role-based systems. Elementary Cryptography. Cryptographic protocols. Introduction to network security.

CS4253 Computer Security

Credit Weighting: 10

Pre-requisite(s): CS1020; CS2010; CS2020

Module Objective: To introduce some of the important concepts in Computer Security and how they are applied in practice.

Module Content: Secrecy, Integrity and Authentication. Threats to computer systems. Identification and authentication. Access control models and the theory of safe systems. Mandatory access control models and mechanisms. Security kernels. Unix, Java2 and Windows-NT security. Assurance and security evaluation criteria. Secret and public key cryptosystems. Message secrecy, integrity and authentication. Cryptographic protocols. Public Key Infrastructures (PKI), certificates and credentials. Design analysis and attacks on security protocols. Security in networked and distributed systems. World Wide Web security. Secure electronic commerce.

CS4310 New Software Product Development

Credit Weighting: 5

Pre-requisite(s): MG3010; MG3011

Module Objective: Aspects of New Software Product Development.

Module Content: Development of New Software Products and Management of the Product Life-Cycle.

CS4311 New Software Enterprise Development

Credit Weighting: 5

Pre-requisite(s): MG3010; MG3011

Module Objective: Aspects of New Software Enterprise Development.

Module Content: Development of new Software Engineering Enterprises.

CS4320 Advanced Web Programming for E-Commerce

Credit Weighting: 10

Module Objective: To teach the techniques of client-side and server-side programming for web-based e-commerce.

Module Content: Client-side programming using HTML 4.0, XHTML and CSS; XML and XSLT; JavaScript and Java. HTTP, CGI, SOAP, WSDL and UDDI. Server-side programming using Perl and PHP; Java servlets and JSP; XML, XML Schema, Xpath, Xlink and XSL. Apart from achieving functionality, the programming techniques presented will emphasise other issues which affect effectiveness, including user-interface design and security.

CS4401 Project

Credit Weighting: 15

Module Objective: Students will gain experience of working on a significant project.

Module Content: Independent or small-group work on a research and/or development project.

MG1003 Introduction to Marketing

Credit Weighting: 5

Module Objective: To introduce students to the principles of Marketing.

Module Content: Introduction to the marketing concept; the history of marketing; the role of the marketing manager; the marketing mix.

MG1004 Introduction to Management and Organisation

Credit Weighting: 5

Module Objective: To introduce students to the nature and process of management and the challenges facing organizations and their leaders in today's competitive business environment.

Module Content: Topics include: the history and evolution of management thought and practice, organisation structure and design, managerial roles and functions, managing in the context of current business problems and opportunities.

MG3011 Organisation and Innovation Fieldwork

Credit Weighting: 5

Pre-requisite(s): MG3010

Module Objective: To give students an awareness of the practical implementation issues associated with managing innovation projects.

Module Content: This module focuses on the actual practices and processes of managing and organising innovation projects in a technology-based environment. Students will study a recently completed project in a local technology-based organisation of the student's choice. Facilitation will be provided in various areas as appropriate: e.g. interview and research techniques, team and group dynamics, collaborations, managing power and influence, managing culture.

MG4008 Small Business Ventures

Credit Weighting: 10

Pre-requisite(s): MG3010 (for Engineering students)

Module Objective: This module will expose students to the issues involved in a small business start-up.

Module Content: This module will utilise small business cases and draw on the experience of Irish entrepreneurs. It will also give students practical experience of business start-up.

EC2206 Business Econometrics and Forecasting

Credit Weighting: 10

Module Objective: The use of economic theory and econometric methods to understand and evaluate the economic environment of business.

Module Content: Cross section and time series techniques are used to determine: the profitability and competitiveness of firms; the operation of the financial markets; and the significance of government policy.

EC4222 Financial Economics

Credit Weighting: 10

Module Objective: To provide an understanding of the financial environment for production and investment.

Module Content: The theory and applied theory of money and capital markets are used to provide an understanding of the financial environment for production and investment in relation to corporate strategy and the finance and treasury functions of firms. Structure of financial markets and operation of financial institutions are also examined.

EC4402 Economic Research Project

Credit Weighting: 15

Module Objective: To prepare and present a research study using economic theory and techniques.

Module Content: Independent work on a research and/or development project.

EC4403 Economic Consulting *(from 2005/2006)*

Credit Weighting: 5

Module Objective: To develop and practice the knowledge and skills required for using economic and financial analysis in carrying out consultancy projects.

Module Content: This module describes the consultancy process and the stages involved in conducting a consultancy project. It examines the skills required in managing a consultant/client relationship. Topics covered include acquiring consultancy projects, briefs and contracts; researching the client business areas; constructing consultancy reports; managing client relationships and a portfolio of clients; professional practice and personal values; ethical principles, dilemmas and conflicts of interest. Case Studies will be used extensively to provide practical experience of the issues.

MA4051 Group Theory

Credit Weighting: 5

Module Objective: To provide an overview of the concepts and theorems of group theory.

Module Content: Groups, subgroups, co-sets and Lagrange's theorem. Conjugacy, normal subgroups and quotient groups. Isomorphism theorems and operators on groups. Cayley's Theorem and generalisations. Sylow theory and applications. Direct products.

MA4052 Functional Analysis

Credit Weighting: 5

Pre-requisite(s): MA3051; MA3056

Module Objective: To provide a grounding in modern functional analysis.

Module Content: A study of the interaction of topological and algebraic structures, of fundamental importance in contemporary mathematics and its applications to physics. Normed linear spaces, Banach spaces, bounded linear operators; Hilbert spaces, convexity, orthogonal sums, Riesz representation theorem for functionals, adjoint operators, spectrum.

MA4053 Project

Credit Weighting: 5

Module Objective: To develop skills of mathematical investigation and report writing.

Module Content: Project on an assigned mathematical topic.

MA4054 Numerical Analysis

Credit Weighting: 5

Pre-requisite(s): MA3051; MA3056; MA4052

Module Objective: To present basic approximation theory and theoretical numerical analysis in order to deepen the students' understanding of numerical methods.

Module Content: Approximation theory, numerical integration, approximate solution of linear operator equations, non-linear inverse problems.

MA4056 Logic and Computation

Credit Weighting: 5

Module Objective: To provide an introduction to the advanced theory of computation and computer related mathematics.

Module Content: Syntax and semantics of first order predicate logic, axioms, proof and truth. Completeness and incompleteness in formal systems. Computable functions, decidable and undecidable predicates. Godel numberings, universal computable functions, halting problem. Applications to theory of computation. Introduction to cardinality and ordinal numbers.

MA4058 Measure Theory and Integration

Credit Weighting: 5

Pre-requisite(s): MA3051; MA3054; MA3056

Co-requisite(s): MA4052

Module Objective: To provide an overview of the theory of measurable sets and integration.

Module Content: Measurable spaces and functions; measures and integrals; integrable functions; convergence theorems; comparison of integrals.

ST3053 Stochastic Processes

Credit Weighting: 5

Pre-requisite(s): ST2051; ST2052

Module Objective: To teach the theory and applications of stochastic processes.

Module Content: Random walk, Poisson process, Markov Chains, Birth-Death Process, Renewal Theory.

ST3054 Survival Analysis

Credit Weighting: 5

Pre-requisite(s): ST2050; ST2051; ST2052; ST2053

Module Objective: To develop techniques for the analysis of survival data.

Module Content: Types of censoring, hazard functions, parametric models, estimation. Non-parametric methods, Kaplan-Meier estimator. Mantel-Haenzel test. Proportional hazard model with covariates. Use of packages.

ST3056 Statistical Simulation

Credit Weighting: 5

Pre-requisite(s): ST2051; ST2052

Module Objective: To teach the theory and applications of statistical simulation.

Module Content: Linear congruential generators for pseudo-random numbers; tests of randomness; generating random variates using inversion, rejection and composition methods; estimating parameters using replication, batch means and regenerative methods; variance reduction techniques including common random numbers, antithetic variates and control variates; implementation of above techniques using a simulation package.

ST3057 Statistical Quality Control

Credit Weighting: 5

Pre-requisite(s): ST2051; ST2052

Module Objective: To develop the theory and methods relating to the application of statistics for the control and improvement of quality.

Module Content: This module develops the theory and methods relating to the statistical control and improvement of quality, and surveys recent developments. Topics include: Quality Management; Acceptance Sampling; Process Control and Process Capability; Continuous Sampling Plans; Specifications and Tolerances.

ST3059 Survey Analysis

Credit Weighting: 5

Pre-requisite(s): ST2051

Module Objective: To develop the theory and methods for the design and analysis of sampling surveys.

Module Content: The theory and methods that relate to the design and analysis of sample survey investigations of finite populations. Topics include: Simple Random Sampling; Stratified Plans; Ratio Estimation; Cluster Sampling; Non-sampling Errors; Case Studies.

ST3064 Time Series

Credit Weighting: 5

Pre-requisite(s): ST2051; ST2052

Module Objective: To teach the theory and applications of time series analysis.

Module Content: Overview of forecasting, including Box-Jenkins, decomposition and exponential smoothing methods; autoregressive and moving average models for stationary time series; identification, estimation and diagnostic checks for a tentative model; forecasting non-stationary and seasonal time series, introduction to non-linear time series, ARCH and GARCH family of models and applications.

ST4050 Statistical Consulting

Credit Weighting: 10

Pre-requisite(s): ST2050; ST2051; ST2052; ST2053

Module Objective: To provide training for work as a statistical consultant.

Module Content: Basic guidelines for consulting. Development of goals. Experience in consulting will be

developed in an apprenticeship format with practical consulting for short-term and long-term clients.

ST4096 Project

Credit Weighting: 15

Module Objective: To develop an understanding of the application of quantitative and computing methods to decision-making problems in management.

Module Content: Linear programming models for resource allocation; graphical and simplex method of solution; sensitivity analysis and duality; multiple management objectives; Network flow models for transportation, job-scheduling and inventory-management; Integer linear programming; Project-management, network-representations and critical-path analysis; resource-levelling and time-cost tradeoffs.

ST4401 Introduction to Operations Research

Credit Weighting: 5

Pre-requisite(s): ST2051 (Science Faculty); ST1021 or ST1023 (Commerce Faculty)

Module Objective: To develop an understanding of the application of quantitative and computing methods to decision-making problems in management.

Module Content: Linear programming models for resource allocation; graphical and simplex method of solution; sensitivity analysis and duality; multiple management objectives; Network flow models for transportation, job-scheduling and inventory management; Integer linear programming; Project-management, network-representations and critical-path analysis; resource-levelling and time-cost tradeoffs.

MA4996 Project

Credit Weighting: 15

Pre-requisite(s): MA3051, MA3052, MA3053, MA3054, MA3056

Module Objective: To enable students prepare and deliver a project in the discipline of Mathematics.

Module Content: Project in the discipline of Mathematics.

Fourth Year CS Modules likely to be offered this year are as follows:

CS4000
CS4010
CS4031
CS4032
CS4034
CS4040
CS4052
CS4054
CS4061
CS4071
CS4092
CS4150
CS4253
CS4320