

Appendix D: Standard ICT Academic Classifications

Department of Education, Science and Training's Fields of Education, based on Australian Standard Classification of Education (ASCED)

DEST's *Field of Education* was introduced in 2001 and "used to describe higher education courses, specialisations and units of study. The main purpose of the classification is to ensure courses, specialisations and units of study with the same or similar vocational emphasis are reliably classified to the same field of education" (DEST, 2002b). It replaces the *Field of Study* and *Academic Organisational Unit Groups codes based on Discipline Groups* categorisations used in the past.

In the post-2001 Fields of Education, ICT areas are mostly grouped under *Information Technology*. Some areas also appear under *Engineering and Management and Commerce*.

Source: 1272.0 Australian Standard Classification of Education (ASCED), available <http://www.abs.gov.au/AUSSTATS/abs%40.nsf/66f306f503e529a5ca25697e0017661f/f501c031bd9ac9c5ca256aaf001fca33!OpenDocument>

02.00.00 INFORMATION TECHNOLOGY

02.01.00 Computer Science

- 02.01.01 Formal Language Theory
- 02.01.03 Programming
- 02.01.05 Computational Theory
- 02.01.07 Compiler Construction
- 02.01.09 Algorithms
- 02.01.11 Data Structures
- 02.01.13 Networks and Communications
- 02.01.15 Computer Graphics
- 02.01.17 Operating Systems
- 02.01.19 Artificial Intelligence
- 02.01.99 Computer Science not elsewhere classified

02.03.00 Information Systems

- 02.03.01 Conceptual Modelling
- 02.03.03 Database Management
- 02.03.05 Systems Analysis and Design
- 02.03.07 Decision Support Systems
- 02.03.99 Information Systems not elsewhere classified

02.99.00 Other Information Technology

- 02.99.01 Security Science
- 02.99.99 Information Technology not elsewhere classified

03.00.00 ENGINEERING AND RELATED TECHNOLOGIES

03.13.00 Electrical and Electronic Engineering and Technology

- 03.13.05 Computer Engineering
- 03.13.07 Communications Technologies

08.00.00 MANAGEMENT AND COMMERCE

08.09.00 Office Studies

- 08.09.03 Keyboard Skills
- 08.09.05 Practical Computing Skills

Australian Standard Research Classification (ASRC) 1998: Chapter 3 - Research Fields, Courses and Disciplines (RFCD) classification

The RFCD classification has been designed primarily to meet the needs of the Australian Bureau of Statistics and the Department of Education, Science and Training. It classifies courses and research projects to field of study/research and classifying units of study to discipline. Areas in ICT is grouped under 280000 *Information, Computing and Communication Sciences*, 291600 *Computer Hardware* and 291700 *Communications Technologies*. The lists is available from <http://www.abs.gov.au/ausstats/abs%40.nsf/66f306f503e529a5ca25697e0017661f/955ffa4eb1b23847ca25697e0018fb14!OpenDocument>. The following is the structure:

Division 280000 Information, Computing and Communication Sciences

280100 Information Systems

280101 Information Systems Organisation

280102 Information Systems Management

280103 Information Storage, Retrieval and Management

280104 Computer-Human Interaction

280105 Interfaces and Presentation (excl. Computer-Human Interaction)

280106 Interorganisational Information Systems

280107 Global Information Systems

280108 Database Management

280109 Decision Support and Group Support Systems

280110 Systems Theory

280111 Conceptual Modelling

280112 Information Systems Development Methodologies

280199 Information Systems not elsewhere classified

280200 Artificial Intelligence and Signal and Image Processing

280201 Expert Systems

280202 Computer Graphics

280203 Image Processing

280204 Signal Processing

280205 Text Processing

280206 Speech Recognition

280207 Pattern Recognition

280208 Computer Vision

280209 Intelligent Robotics

280210 Simulation and Modelling

280211 Virtual Reality and Related Simulation

280212 Neural Networks, Genetic Algorithms and Fuzzy Logic

280213 Other Artificial Intelligence

280300 Computer Software

280301 Programming Techniques

280302 Software Engineering

280303 Programming Languages

280304 Operating Systems

280305 Multimedia Programming

280399 Computer Software not elsewhere classified

- 280400 Computation Theory and Mathematics
 - 280401 Analysis of Algorithms and Complexity
 - 280402 Mathematical Logic and Formal Languages
 - 280403 Logics and Meanings of Programs
 - 280404 Numerical Analysis
 - 280405 Discrete Mathematics
 - 280406 Mathematical Software
 - 280499 Computation Theory and Mathematics not elsewhere classified
- 280500 Data Format
 - 280501 Data Structures
 - 280502 Data Storage Representations
 - 280503 Files
 - 280504 Data Encryption
 - 280505 Data Security
 - 280506 Coding and Information Theory
 - 280599 Data Format not elsewhere classified
- 289900 Other Information, Computing and Communication Sciences
 - 289999 Other Information, Computing and Communication Sciences

Division 290000 Engineering and Technology

- 291600 Computer Hardware
 - 291601 Arithmetic and Logic Structures
 - 291602 Memory Structures
 - 291603 Input, Output and Data Devices
 - 291604 Logic Design
 - 291605 Processor Architectures
 - 291699 Computer Hardware not elsewhere classified
- 291700 Communications Technologies
 - 291701 Antenna Technology
 - 291702 Optical and Photonic Systems
 - 291703 Digital Systems
 - 291704 Computer Communications Networks
 - 291705 Microwave and Millimetrewave Technology
 - 291706 Broadband Network Technology
 - 291707 Modem Technology
 - 291708 Baseband Technology
 - 291709 Satellite Communications
 - 291710 Radio Communications and Broadcasting not elsewhere classified
 - 291799 Communications Technologies not elsewhere classified

ISCED 1997 Broad Groups and Fields of Education

The International Standard Classification of Education (ISCED) was designed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) to serve as an instrument suitable for assembling, compiling and presenting statistics of education both within individual countries and internationally. The present classification, known as ISCED 1997, was approved by the UNESCO General

Conference at its 29th session in November 1997. The classification details are available from http://www.uis.unesco.org/en/act/act_p/iscd.html.

In ISCED 1997, ICT is classified in two groups, emphasising the software versus hardware difference:

48 Computing

Computer sciences: system design, computer programming, data processing, networks, operating systems - software development only (hardware development should be classified with the engineering fields).

52 Engineering and engineering trades

Engineering drawing, mechanics, metal work, electricity, electronics, telecommunications, energy and chemical engineering, vehicle maintenance, surveying.

ACS Areas of Knowledge

From Australian Computer Society (ACS) Areas of Knowledge 5.1 - 5.14:
<http://www.acs.org.au/static/national/pospaper/bokpt1.htm>

5.1 Computer Organisation and Architecture

- Computer Architecture and Instruction Set Design
- Review of Assembly Language Instructions with particular emphasis on instructions used in I/O programming
- Interfacing assembly language routines with a high level language (e.g. C)
- The Operation of Basic System Utilities - Assembler, Linker & Loader
- An Introduction to I/O Programming
 - Accessing I/O devices and polled I/O
 - Interrupt driven I/O
 - Interrupt Controllers and the Interrupt Mechanism
 - DMA and IO Channels
- Memory
 - An overview of Memory Module Design
 - The principles of operation of Cache Memory
 - The principles of operation of Virtual Memory Systems
- The Operation of the CPU
 - Overview of Control Unit Design - Hardwired vs Microprogrammed
 - Arithmetic Logic Unit - Carry Prediction (at gate level)
 - Pipelining - issues involved in Arithmetic and Instruction pipeline design
 - CISC vs RISC
- Review of the Implementation of DOS and UNIX File Systems

5.2 Conceptual Modelling

- Abstraction and Modelling
 - Abstraction and modelling - classification, classes, types and instances, generalisation, inheritance, association and aggregation. Models as partial views providing particular perspectives - data, processes, objects, events and time, locations, user and organisational structures and roles, motivations and business purposes.
- Semantic data modelling

- Entity relationship modelling - entity types, relationship types and attribute types
- The Relational Data Model
 - Transforming entity relationship models into relational models
 - Set theory
 - Relational structures - domains, base relations, virtual relations, tuples, attributes, candidate, primary and foreign keys
 - Relational integrity constraints - entity, referential and domain integrity
 - Relational manipulation operations - relational algebra and calculus
- Normalisation
 - Anomalies caused by redundant data in relations
 - Functional dependency, normalisation and normal forms
- The Structured Query Language
 - Data definition statements - create, drop, alter
 - Data manipulation statements - select, update, delete and insert
 - Access control statements - grant, revoke

5.3 Database Management

- File Processing
 - I/O operations
 - physical and logical files
 - buffer management
- File Structure Concepts
 - file access
 - performance issues
 - indexed files
 - B-trees
 - indexed sequential access
 - B+trees
 - VSAM files
 - hashing
- Schema Architecture
 - fact based
 - relational
 - hierarchical
 - network
- Query Languages
 - foundations
 - query processing and optimisation
- Concurrency Control
- Crash Recovery and Transaction Management

5.4 Data Communications and Networks

- Signals, Impairments and Media
- Communications Techniques
- Link Control and Efficiency
- Networking
- Local Area Networks
- Wide Area Networks
- Network Management
- Network Security
- Network Applications

5.5 Data Structures and Algorithms

- Data Types
- Simple data types
 - numeric, text
- Structured data types
 - arrays, records
- Abstract data types
 - stacks, queues, linked lists, trees
- File Organisation and Processing
 - serial/sequential files, indexed files, hash- addressed files
 - sequential and direct access methods
- Typical Operations on Data Structures
 - construction
 - sorting, searching, indexing
 - updating - additions/deletions/amendments
- Implementation/Representation
 - internal representation of data types
 - file index structures
 - treatment of collisions and overflow

5.6 Discrete Mathematics

- Computer Arithmetic
 - Numbering systems e.g., decimal, binary, octal and hexadecimal
- Set Theory
 - Definitions and notation
 - Venn diagrams
 - Set operations
 - The algebra of sets
 - Enumeration techniques
 - permutations and combinations
 - Inclusion/exclusion principle
 - Multinomial coefficients
- Logic
 - Simple and compound propositions
 - Propositional calculus
 - Truth tables
 - Properties of logic
- Boolean Algebra
 - Axioms
 - Functions and their determination
 - Switching circuits and properties
 - Normal forms
 - Simplification of Boolean functions and networks
- Graph Theory
 - Graphs
 - Euler and Hamiltonian graphs
 - Isomorphisms and isomorphic graphs
 - Planar graphs
 - Applications
- Matrix Theory
 - Definition of a matrix
 - Basic operations and the algebra of matrices
 - Applications

5.7 Ethics/Social Implications/Professional Practice

- Introduction
 - What's Ethics got to do with me?
- Social Issues
 - Culture and heritage
 - Culture and technology
- Global issues
- Organisational issues
 - Application of technology in Australian business
 - Ethical issues in private and public sectors
- Technology
- Belief Systems
 - The law and computer crime
 - Reliability, safety in software systems
- Individual
 - Responsibility - personal and community
- IT Professional Codes
 - ACS Code of Ethics
 - ACS Code of Conduct

5.8 Interpersonal Communications

- Written communication
 - effective expression
 - logical ordering of ideas
 - format and content of reports and formal documents
 - technical writing and documentation proposals and procedures
- Verbal communication
 - structuring material for oral presentation
 - visual presentation of information
 - the use of appropriate supporting technology
 - effective speaking and audience management
- Interpersonal skills
 - interview techniques
 - managing group dynamics
 - technical reviews
 - formal and informal meetings
 - negotiation skills
 - team management and conflict resolution

5.9 Program Design and Implementation

- Program specification
 - design of documentation to specify the requirements of a program
- Program design
 - algorithm design and associated documentation
 - program structure and logic
 - data design
- Programming languages
 - levels of languages in terms of machine vs user orientation
 - suitability of languages for problem domains
 - an appreciation of the operation of programs at machine level
- Program implementation
 - structure and syntax of a programming language
 - the procedures of editing, compiling, linking, etc, needed to produce an executable program

- internal documentation issues
- Program testing
 - formal proof of correctness vs testing procedures
 - design of test data
 - program testing methods
- Program documentation
 - internal and external program documentation
 - differing documentation requirements for technical staff and users
- Programming paradigms
 - an appreciation of the existence of and fundamental differences between procedural, functional, logic and object-oriented paradigms

5.10 Project Management and Quality Assurance

- Concepts and Models
 - project definition
 - project success
 - measuring success
 - post-implementation reviews
 - project size
 - lines of code
 - effort/duration
 - function points
 - project life cycle
- Project Management Techniques
 - steering committees
 - project justification
 - project planning
 - project development strategies
 - methodologies
 - risk assessment
 - estimation
 - quality assurance
 - scheduling
 - project tracking and reporting
- Introduction to Software quality
 - Understanding and Measuring Quality
 - The Costs and Benefits of Quality
 - Role of People in Producing Quality Software
 - Factors that Impact the Quality of Software
- Software Quality Planning
 - Role of Planning
 - Software Quality Requirements
 - Preparing a Software Quality Plan
 - Implementing a Software Quality Plan
 - Preparing a Quality Manual
- Processes for Assuring the Quality of Software
 - Risk Management
 - Conformance to Standards
 - Reviews, Audits, Walkthroughs and Inspections
 - Verification, Validation and Testing
 - Configuration Management
- Product Quality
 - Software Product Standards

- Quality Attributes of Software
 - Product Characteristics of Quality Software
 - Measuring and Evaluating Product Quality and Associated Metrics
- Process Quality
 - Software Process Standards
 - Process Definition
 - Process Measurement
- Process Assessment
 - Process Improvement
 - Capability Evaluation
 - Procurement of Software
- Post Development Software Quality Assurance
 - Maintenance and Evolution of Software
 - Re-engineering of Software
 - Software Product Quality Improvement

5.11 Information Security

- Historical Background
 - role of information technology professionals
- Societal, Governmental and Legal Imperatives for Information Systems
 - Security and Privacy
 - International guidelines (OECD Privacy and Information Systems Security Guidelines)
 - Regional security requirements (European Community)
 - Legal requirements - Australia's Privacy Act, State privacy and computer security / crime related Acts and Regulations
 - Australian standards for information security
- Professional Responsibility and Information Systems Security
 - Relationships between concepts of Quality, Safety, Reliability, and Security / Software Engineering
- Computer Security
 - Hardware requirements and features
 - Operating systems security
 - Access control, Authentication, Integrity, Confidentiality
e.g. RACF, ACF-2, etc.
 - UNIX security (an example of techniques)
 - Database security
 - Personal computer/Small systems security
- Security Technologies
 - Access control mechanisms
 - Algorithms - Hash, One-way and Related Functions / SHA, ISO
 - Cryptography
 - Symmetric and Asymmetric techniques
 - commonly-used ciphers: DES, RSA, RC2-4, IDEA, SAFER, etc.
 - Key Management
 - Modes of usage
 - Authentication architectures
 - third party schemes/certificates
- Network Security
 - early proprietary and mainframe technologies - IBM, DEC

- Open Systems Interconnection security architecture (ISO 7498-2)
 - security services and mechanisms
 - MIT "Kerberos"
 - ECMA model - "SESAME"
 - security and telecommunications services
 - computer-telephone integration
- Trusted Systems and Networks
 - "Rainbow" series (USA) / National Criteria, e.g. Canada, Australia, and others
 - ITSEC / ITSEM (Europe)
 - concepts of security functionality and enforcement/verification
 - Common criteria
 - Significance of trusted systems technologies
 - verification techniques and software engineering
- Security in the Distributed Systems (Client/Server) and Object Oriented Environments
- Security and Specific Industry Requirements
 - Health care industry
 - Banking and finance industry
 - Commercial and military government systems
- Security Management
 - Responsibilities
 - Organisation
 - Management requirements

5.12 Software Engineering and Methodologies

- Fundamentals of Software Engineering
 - requirements analysis
 - functional and technical specifications
 - process, data and object orientation models
 - documentation standards
 - software testing
 - software maintenance
 - software quality assurance
 - formal specification methods
 - software configuration management
- Project Management
 - project planning, estimation and control
 - project evaluation and control techniques
 - team construction and management
 - principles of software project management
 - prototyping

5.13 Systems Analysis and Design

- Role of Information Systems in an Organisation
- System Development Methodologies
 - Different systems development life cycle models such as waterfall, spiral, evolutionary, prototyping
 - Phases, stages, activities and stakeholders, deliverables, models and modelling techniques.
 - Common system development methodologies - structured analysis and design, information engineering and object oriented approaches

- Fact Finding Techniques
 - discussions, forms and documents, observation.
- The role of Models and Modelling Techniques
 - A framework for relating and understanding models - planning, analysis, design and implementation stages versus data, process, behaviour, location, organisation and motivation perspectives.
- Business Area Analysis
 - Problems, participants, physical versus essential models,
 - Typical modelling techniques based on any one development methodology or paradigm which may include data flow diagrams, functional decomposition diagrams, functional dependency diagrams, decision tables / trees, state transition diagrams, process descriptions, entity relationship diagrams, class diagrams, object diagrams, interaction diagrams, module diagrams, etc.
- Business Systems Design
 - Constraints, problems and participants. Deciding on the automation boundary. Design options. Typical modelling techniques based on any one development methodology or paradigm which may include structure charts, dialog flow diagrams, module diagrams, call graphs, etc. User interface design - ergonomics, data entry and validation, input forms, windows, window objects, screens and reports. Transforming analysis models into design models.
- Supporting Analysis and Design
 - The use of proformas and standards, system dictionaries and CASE tools.
- Project Management
 - Team structures, project scenarios, risk assessment, monitoring and measurement, tools PERT/ CPM
- Quality Assurance
 - Walkthroughs, inspections, reviews, consistency checks

5.14 Systems Software

- An operating system at the user level
 - command processing and scripts
 - security and administration in a modern operating system
- An operating system at the systems programming level
 - an operating system kernel
 - low-level facilities;
 - processes and state vectors;
 - hardware interface via interrupt handling
- Process management, including:
 - process synchronisation
 - process scheduling
 - models for interprocess communication (ipc)
 - threads and thread management
 - specification of concurrent systems
- Resource management, including:
 - file system and device (i/o) management
 - deadlock preconditions and process graphs
 - memory management issues and algorithms

CC2001 Computer Science Body of Knowledge

From Computing Curricula 2001 project (CC2001), a joint undertaking of the Computer Society of the Institute for Electrical and Electronic Engineers (IEEE-CS) and the Association for Computing Machinery (ACM). Further detailed breakdown is available from <http://www.acm.org/sigcse/cc2001/>.

Discrete Structures (DS)

- ▣DS1. Functions, relations, and sets [core]
- ▣DS2. Basic logic [core]
- ▣DS3. Proof techniques [core]
- ▣DS4. Basics of counting [core]
- ▣DS5. Graphs and trees [core]
- ▣DS6. Discrete probability [core]

Programming Fundamentals (PF)

- ▣PF1. Fundamental programming constructs [core]
- ▣PF2. Algorithms and problem-solving [core]
- ▣PF3. Fundamental data structures [core]
- ▣PF4. Recursion [core]
- ▣PF5. Event-driven programming [core]

Algorithms and Complexity (AL)

- ▣AL1. Basic algorithmic analysis [core]
- ▣AL2. Algorithmic strategies [core]
- ▣AL3. Fundamental computing algorithms [core]
- ▣AL4. Distributed algorithms [core]
- ▣AL5. Basic computability [core]
- ▣AL6. The complexity classes P and NP [elective]
- ▣AL7. Automata theory [elective]
- ▣AL8. Advanced algorithmic analysis [elective]
- ▣AL9. Cryptographic algorithms [elective]
- ▣AL10. Geometric algorithms [elective]
- ▣AL11. Parallel algorithms [elective]

Architecture and Organization (AR)

- ▣AR1. Digital logic and digital systems [core]
- ▣AR2. Machine level representation of data [core]
- ▣AR3. Assembly level machine organization [core]
- ▣AR4. Memory system organization and architecture [core]
- ▣AR5. Interfacing and communication [core]
- ▣AR6. Functional organization [core]
- ▣AR7. Multiprocessing and alternative architectures [core]
- ▣AR8. Performance enhancements [elective]
- ▣AR9. Architecture for networks and distributed systems [elective]

Operating Systems (OS)

- ▣OS1. Overview of operating systems [core]
- ▣OS2. Operating system principles [core]
- ▣OS3. Concurrency [core]

- OS4. Scheduling and dispatch [core]
- OS5. Memory management [core]
- OS6. Device management [elective]
- OS7. Security and protection [elective]
- OS8. File systems [elective]
- OS9. Real-time and embedded systems [elective]
- OS10. Fault tolerance [elective]
- OS11. System performance evaluation [elective]
- OS12. Scripting [elective]

Net-Centric Computing (NC)

- NC1. Introduction to net-centric computing [core]
- NC2. Communication and networking [core]
- NC3. Network security [core]
- NC4. The web as an example of client-server computing [core]
- NC5. Building web applications [elective]
- NC6. Network management [elective]
- NC7. Compression and decompression [elective]
- NC8. Multimedia data technologies [elective]
- NC9. Wireless and mobile computing [elective]

Programming Languages (PL)

- PL1. Overview of programming languages [core]
- PL2. Virtual machines [core]
- PL3. Introduction to language translation [core]
- PL4. Declarations and types [core]
- PL5. Abstraction mechanisms [core]
- PL6. Object-oriented programming [core]
- PL7. Functional programming [elective]
- PL8. Language translation systems [elective]
- PL9. Type systems [elective]
- PL10. Programming language semantics [elective]
- PL11. Programming language design [elective]

Human-Computer Interaction (HC)

- HC1. Foundations of human-computer interaction [core]
- HC2. Building a simple graphical user interface [core]
- HC3. Human-centered software evaluation [elective]
- HC4. Human-centered software development [elective]
- HC5. Graphical user-interface design [elective]
- HC6. Graphical user-interface programming [elective]
- HC7. HCI aspects of multimedia systems [elective]
- HC8. HCI aspects of collaboration and communication [elective]

Graphics and Visual Computing (GV)

- GV1. Fundamental techniques in graphics [core]
- GV2. Graphic systems [core]
- GV3. Graphic communication [elective]
- GV4. Geometric modeling [elective]
- GV5. Basic rendering [elective]

- GV6. Advanced rendering [elective]
- GV7. Advanced techniques [elective]
- GV8. Computer animation [elective]
- GV9. Visualization [elective]
- GV10. Virtual reality [elective]
- GV11. Computer vision [elective]

Intelligent Systems (IS)

- IS1. Fundamental issues in intelligent systems [core]
- IS2. Search and constraint satisfaction [core]
- IS3. Knowledge representation and reasoning [core]
- IS4. Advanced search [elective]
- IS5. Advanced knowledge representation and reasoning [elective]
- IS6. Agents [elective]
- IS7. Natural language processing [elective]
- IS8. Machine learning and neural networks [elective]
- IS9. AI planning systems [elective]
- IS10. Robotics [elective]

Information Management (IM)

- IM1. Information models and systems [core]
- IM2. Database systems [core]
- IM3. Data modeling [core]
- IM4. Relational databases [elective]
- IM5. Database query languages [elective]
- IM6. Relational database design [elective]
- IM7. Transaction processing [elective]
- IM8. Distributed databases [elective]
- IM9. Physical database design [elective]
- IM10. Data mining [elective]
- IM11. Information storage and retrieval [elective]
- IM12. Hypertext and hypermedia [elective]
- IM13. Multimedia information and systems [elective]
- IM14. Digital libraries [elective]

Social and Professional Issues (SP)

- SP1. History of computing [core]
- SP2. Social context of computing [core]
- SP3. Methods and tools of analysis [core]
- SP4. Professional and ethical responsibilities [core]
- SP5. Risks and liabilities of computer-based systems [core]
- SP6. Intellectual property [core]
- SP7. Privacy and civil liberties [core]
- SP8. Computer crime [elective]
- SP9. Economic issues in computing [elective]
- SP10. Philosophical frameworks [elective]

Software Engineering (SE)

- SE1. Software design [core]
- SE2. Using APIs [core]

- SE3. Software tools and environments [core]
- SE4. Software processes [core]
- SE5. Software requirements and specifications [core]
- SE6. Software validation [core]
- SE7. Software evolution [core]
- SE8. Software project management [core]
- SE9. Component-based computing [elective]
- SE10. Formal methods [elective]
- SE11. Software reliability [elective]
- SE12. Specialized systems development [elective]

Computational Science and Numerical Methods (CN)

- CN1. Numerical analysis [elective]
- CN2. Operations research [elective]
- CN3. Modeling and simulation [elective]
- CN4. High-performance computing [elective]

IS'97 Body of Information Systems Knowledge

From Information Systems '97 (IS'97), formed by a collaborative joint task force of the Association for Computing Machinery (ACM), the Association for Information Systems (AIS), and the Association of Information Technology Professionals (AITP). Further details are available at <http://www.is2000.org/is97/rev/review1.html>.

1.0 Information technology

1.1 Computer architectures

- 1.1.1 Fundamental data representation: non-numeric, numeric (integers, reals, errors, precision)
- 1.1.2 Physical representation of digitized information: e.g., data, text, image, voice, video
- 1.1.3 CPU architectures: CPU, memory, registers, addressing modes, instruction sets
- 1.1.4 Computer system components: busses, controllers, storage systems, peripheral devices
- 1.1.5 Multiprocessor architectures
- 1.1.6 Digital logic and systems

1.2 Algorithms and data structures

- 1.2.1 Formal problems and problem solving
- 1.2.2 Basic data structures: lists, arrays, strings, records, sets, linked-lists, stacks, queues, trees, graphs
- 1.2.3 Complex data structures: e.g., of data, text, voice, image, video, hypermedia
- 1.2.4 Abstract data types
- 1.2.5 File structures: sequential, direct access, hashing, indexed
- 1.2.6 Sorting and searching data structures and algorithms
- 1.2.7 Algorithm efficiency, complexity and metrics
- 1.2.8 Recursive algorithms
- 1.2.9 Neural networks and genetic algorithms

1.2.10 Advanced considerations

1.3 Programming languages

- 1.3.1 Fundamental programming language structures; comparison of languages and applications
- 1.3.2 Machine and assembly level languages
- 1.3.3 Procedural languages
- 1.3.4 Non-procedural languages: logic, functional, event driven
- 1.3.5 Fourth-generation languages
- 1.3.6 Object oriented extensions to languages
- 1.3.7 Programming languages, design, implementation and comparison

1.4 Operating systems

- 1.4.1 Architecture, goals and structure of an operating system; structuring methods, layered models, object-server model
- 1.4.2 Interaction of operating system and hardware architecture
- 1.4.3 Process management: concurrent processes, synchronization
- 1.4.4 Memory management
- 1.4.5 Resource allocation and scheduling
- 1.4.6 Secondary storage management
- 1.4.7 File and directory systems
- 1.4.8 Protection and security
- 1.4.9 Distributed operating systems
- 1.4.10 OS support for human interaction: e.g., GUI, interactive video
- 1.4.11 OS interoperability and compatibility: e.g., open systems
- 1.4.12 Operating system utilities, tools, commands and shell programming
- 1.4.13 System administration and management

1.5 Telecommunications

- 1.5.1 International telecommunication standards, models, trends
- 1.5.2 Data transmission: media, signaling techniques, transmission impairments, encoding, error detection, compression
- 1.5.3 Line configuration: error control, flow control, multiplexing
- 1.5.4 Local area networks
- 1.5.5 Wide area networks: switching techniques, broadcast techniques, routing
- 1.5.6 Network architectures and protocols
- 1.5.7 Internetworking
- 1.5.8 Network configuration, performance analysis and monitoring
- 1.5.9 Network security: encryption, digital signatures, authentication
- 1.5.10 High-speed networks: e.g., broadband ISDN, SMDS, ATM, FDDI
- 1.5.11 Emerging networks: ATM, ISDN, satellite nets, optic nets, etc., integrated voice, data and video
- 1.5.12 Application: e.g., client server, EDI, EFT, phone network, e-mail, multimedia, video conferencing, value-added networks

1.6 Database

- 1.6.1 DBMS: features, functions, architecture
- 1.6.2 Data models: relational, hierarchical, network, object, semantic object
- 1.6.3 Normalization
- 1.6.4 Integrity (referential, data item, intra-relation): representing relationships; entity and referential integrity
- 1.6.5 Data definition languages (schema definition languages, graphical development tools, dictionaries, etc.)
- 1.6.6 Application interface
- 1.6.7 Intelligent query processors and query organization, OLAP tools
- 1.6.8 Distributed databases, repositories and warehouses
- 1.6.9 DBMS products: recent developments in database systems (e.g., hypertext, hypermedia, optical disks)
- 1.6.10 Database machines and servers
- 1.6.11 Data and database administration
- 1.6.12 Data dictionary, encyclopedia, repository
- 1.6.13. Information retrieval: e.g. internet tools, image processing, hypermedia

1.7 Artificial intelligence

- 1.7.1 Knowledge representation
- 1.7.2 Knowledge engineering
- 1.7.3 Inference processing
- 1.7.4 Other techniques: fuzzy logic, CASE-based reasoning, natural language and speech recognition
- 1.7.5 Knowledge-based systems

2.0 Organizational and management concepts

2.1 General organization theory

- 2.1.1 Hierarchical and flow models of organizations
- 2.1.2 Organizational work groups
- 2.1.3 Organizational span: single user, work group, team, enterprise, global
- 2.1.4 Role of IS within the enterprise: strategic, tactical and operations
- 2.1.5 Effect of IS on organizational structure; IS and continuous improvement
- 2.1.6 Organizational structure: centralized, decentralized, matrix
- 2.1.7 Organizational issues pertaining to use of software systems in organizations

2.2 Information systems management

- 2.2.1 IS planning
- 2.2.2 Control of the IS function: e.g., EDP auditing, outsourcing
- 2.2.3 Staffing and human resource management
- 2.2.4 IS functional structures -- internal vs outsourcing
- 2.2.5 Determining goals and objectives of the IS organization
- 2.2.6 Managing IS as a business: e.g., customer definition, defining IS mission, IS critical success factors
- 2.2.7 CIO and staff functions

2.2.8 IS as a service function: performance evaluation --
external/internal, marketing of services

3.0 Theory and Development of Systems

- 3.1 Systems and Information Concepts
- 3.2 Approaches to Systems Development
- 3.3 Systems Development Concepts and Methodologies
- 3.4 Systems Development Tools and Techniques
- 3.5 Application Planning
- 3.6 Risk Management
- 3.7 Project Management
- 3.8 Information and Business Analysis
- 3.9 Information Systems Design
- 3.10 Systems Implementation and Testing Strategies
- 3.11 Systems Operation and Maintenance
- 3.12 Systems Development for Specific Types of Information Systems

Career Space Consortium's Generic Skills Profiles

Career Space is a consortium of eleven major ICT companies and the European ICT Industry Association (EICTA), formed to promote ICT and to advise the European Commission on narrowing the ICT skill gaps. The ICT companies are BT, Cisco Systems, IBM Europe, Intel, Microsoft Europe, Nokia, Nortel Networks, Philips Semiconductors, Siemens AG, Telefónica S.A. and Thales.

The Consortium released a set of Curriculum Guidelines <<http://www.career-space.com/cdguide/index.htm>>. Part of the Guidelines defines the following set of *Generic Skills Profiles* to be used as reference point modules for Universities to mix and derive their own curricula.

- Software Architecture and Design
- Software and Application Development
- IT Business Consultancy
- Systems Specialist
- Multimedia
- Data Communications Engineering
- Integration & Test / Implementation and Test Engineering
- Product Design
- Communications Network Design
- Technical Support
- Digital Design
- Digital Signal Processing (DSP) Application Design
- Radio Frequency (RF) Engineering

