EUROPEAN CERTIFICATION OF INFORMATICS PROFESSIONALS CORE SYLLABUS 3.0

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The official version of EUCIP Core Syllabus Version 3.0 is the version published on the EUCIP website, which can be found at: www.eucip.org

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EUCIP Core Syllabus 3.0 Contents

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MODULE A – "PLAN" KNOWLEDGE AREA
USE AND MANAGEMENT OF INFORMATION SYSTEMS

The following is the Syllabus for Module A, Plan, which provides the basis for the tests in this module domain.

Module Goals

EUCIP CORE: **Plan Knowledge Area**	Module A, Plan, requires the candidate to appreciate the use and management of Information Systems.

The candidate shall be able to:

- Understand organisations and their use of ICT, as an enabler for effective Information Systems and a platform for innovation.
- Understand organisational strategies and business processes.
- Recognise issues related to the management of ICT, such as selecting the appropriate technology, or choosing between in-house systems development or outsourcing.
- Measure the value of IT investments through the use of feasibility studies, and costs and benefits analysis.
- Understand possibilities for e-business, virtual organisations and the use of enterprise applications resulting from the global networked economy.
- Appreciate the requirement for a professional approach to project management and quality assurance. Recognise the role of innovation and the challenge of promoting it.
- Understand the importance of physical and distributed teams, the business implications for social networking technology and the importance of effective communication when presenting the case for change within an organisation.
- Appreciate some of the legal and ethical aspects of ICT.

CATEGORY	TOPIC	REF.	ITEM
A.1 Organisations and their Use of ICT	*A.1.1 Organisational Types and Structures*	A.1.1.1	Describe organisations and major organisational types in terms of their internal structures such as hierarchical, flat; legal status such as charity, partnership; size such as SME, corporation.
		A.1.1.2	Describe the importance of information in an organisation for operational, tactical and strategic decision-making processes.

CATEGORY	TOPIC	REF.	ITEM
		A.1.1.3	Outline how diagrams can demonstrate workflow within different organisations.
		A.1.1.4	Outline the typical uses of ICT within an organisation, such as data processing, automation, personal productivity tools, knowledge sharing, integrated e-business.
		A.1.1.5	Outline how different organisational cultures impact on ICT policies.
	A.1.2 Information Processing	A.1.2.1	Outline the difference between data and information.
		A.1.2.2	Outline how diagrams can show information processing systems in terms of inputs, processing and outputs.
		A.1.2.3	Describe the use of information processing systems within an organisation, such as enterprise management, transaction processing, process control systems.
	A.1.3 Strategic Positioning	A.1.3.1	Recognise the position of an organisation in terms of industry classification, role in the value chain, market maturity and rivalry, range of products/services, processes.
		A.1.3.2	Describe how an organisation can determine its service strategy, such as Engineer To Order, Make To Order, Assemble To Order, Make To Stock. Outline the impact service strategy will have on planning and control.
		A.1.3.3	Outline external and internal factors affecting an organisation, such as international markets, competitors, stakeholders, the environment.
	A.1.4 Business Plans	A.1.4.1	Outline the typical components of a business plan and its relevance for investors.

CATEGORY	TOPIC	REF.	ITEM
		A.1.4.2	Describe the role of performance indicators and analysis techniques, such as SWOT, in relating business strategies to market and environmental factors.
		A.1.4.3	Describe a suitable ICT solution for a given business plan.
	A.1.5 Business Processes	A.1.5.1	Understand the concept of business processes and differentiate between primary and support processes.
		A.1.5.2	Describe major enterprise application types, such as Enterprise Resource Planning, Customer Relationship Management and recognise the business processes that they support.
		A.1.5.3	Recognise the business processes used by organisations in different sectors, such as construction, manufacturing, financial service, sales, public administration, research and development.
		A.1.5.4	Outline key strategies for improving organisational competitiveness, such as knowledge sharing between internal functions, care for the client, and describe how ICT systems can support these initiatives.
	A.1.6 IS Support for Organisational Management	A.1.6.1	Describe the roles and responsibilities of management at strategic, tactical and operational level.
		A.1.6.2	Relate various categories of ICT applications to the different management levels.
		A.1.6.3	Define organisational knowledge, memory and learning.
		A.1.6.4	Outline some common decision-making and business measurement methods, such as Pareto diagram, Ishikawa diagram, Critical Success Factors, Key Performance Indicators, Balanced Score Card.

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CATEGORY	TOPIC	REF.	ITEM
		A.1.6.5	Describe the support Management Information Systems (MIS) provides in an organisation and outline some MIS applications.
	A.1.7 Collaborative Technologies	A.1.7.1	Define collaborative technologies and list their main features and applications.
		A.1.7.2	Define the purpose of workflow management systems and their advantages compared to less formal systems, such as blogs, discussion boards.
		A.1.7.3	Distinguish between virtual teamworking and physical, co-located teamworking.
		A.1.7.4	Outline the factors for successful implementation of computer-based collaborative work, such as management support, leadership, organisational culture, technology availability, usability, adaptability, technical support.
	A.1.8 Computer Based Training and e-Learning	A.1.8.1	Describe computer-based training (CBT) and e-learning.
		A.1.8.2	List the technical requirements for using multimedia, CBT, and virtual classrooms.
		A.1.8.3	List the advantages and disadvantages of e-learning.
	A.1.9 The Information Society	A.1.9.1	Describe how information and communication technologies have transformed society.
		A.1.9.2	List the advantages and disadvantages of ICT in society.
		A.1.9.3	Define the term digital divide.
A.2 Management of ICT	A.2.1 ICT Strategy	A.2.1.1	Recognise the need for an ICT strategy and outline the purpose of having an ICT strategy.
		A.2.1.2	Describe the importance of aligning ICT strategy with business strategy.

CATEGORY	TOPIC	REF.	ITEM
		A.2.1.3	Describe how ICT can be used to support the business by relating the ICT components of an Information System (IS) to the business processes they support.
		A.2.1.4	Describe how ICT can be used to increase an organisation's flexibility, such as IT as an enabler of the industrialisation of services (e.g. offshoring), Software as a Service (SaaS), industry specific roles of IT.
		A.2.1.5	Describe the differing strategic roles of ICT staff in supporting the business, such as CIO (Chief Information Officer), CSO (Chief Security Officer), CKO (Chief Knowledge Officer).
	A.2.2 The ICT Needs of Different Organisations	A.2.2.1	Describe different information sharing models, such as hierarchical, distributed, and the corresponding requirements for the organisation.
		A.2.2.2	Outline different scenarios showing appropriate matches between organisational need and ICT.
		A.2.2.3	Identify business-critical ICT services and related components.
		A.2.2.4	Understand the concept of Personal Information Management (PIM) and its benefit in supporting information acquisition, storage, retrieval and use.
	A.2.3 Mapping ICT Solutions	A.2.3.1	Outline the key attributes of transaction processing systems, process control systems, planning systems, automation systems, decision support systems.
		A.2.3.2	Describe the importance of databases for recording transactions, data warehousing and gaining business intelligence.
	A.2.4 Systems Development versus Systems Procurement or Outsourcing	A.2.4.1	Outline the human, technical and financial considerations in systems development.

CATEGORY	TOPIC	REF.	ITEM
		A.2.4.2	Recognise typical examples of ICT procurement or outsourcing.
		A.2.4.3	List the most common reasons for outsourcing from a business perspective.
		A.2.4.4	List the advantages and disadvantages of systems development versus outsourcing.
		A.2.4.5	Outline the factors for consideration prior to taking a build or buy decision.
	A.2.5 Staff Management	A.2.5.1	Describe the different roles involved in developing and maintaining Information Systems, such as Systems Analysts, Business Analysts, Software Developer, Network Manager, Database Manager.[1]
		A.2.5.2	Define the concept of end user computing, and outline the roles and responsibilities of the end user and the ICT staff.
		A.2.5.3	Outline the advantages and disadvantages of outsourcing systems development in relation to staff issues.
		A.2.5.4	Understand the factors involved in retaining skilled staff, such as HR policies, job mobility, workplace environment, compensation, professional development, career planning.
	A.2.6 IS Quality Management	A.2.6.1	Describe some of the attributes of quality in the context of evaluating Information Systems quality.
		A.2.6.2	Outline major approaches to quality management, such as Total Quality Management (TQM), Capability Maturity Model Integration (CMMI), International Organization for Standardization (ISO) certification, European Foundation for Quality Management (EFQM), Common Assessment Framework (CAF).

[1] See www.eucip.org for a full listing of IT Professional profiles as defined by EUCIP.

CATEGORY	TOPIC	REF.	ITEM
		A.2.6.3	Define the major risks associated with a lack of quality in an IS.
		A.2.6.4	Describe the need for monitoring and evaluation of ICT investments.
		A.2.6.5	Define Total Cost of Ownership (TCO) and list the typical cost items for ICT systems.
A.3 Measuring the Value of ICT	A.3.1 The Concept of the Client	A.3.1.1	Define the concept of stakeholders in a business.
		A.3.1.2	Differentiate between different meanings of client as external purchaser, project sponsor or user/recipient of ICT services.
	A.3.2 Business Plans and Feasibility Studies	A.3.2.1	Understand that ICT must support organisational business plans.
		A.3.2.2	Describe the process of assessing the feasibility of Information System plans and matching them with business needs/plans.
		A.3.2.3	Define the term economic feasibility.
		A.3.2.4	Define the term technical feasibility.
		A.3.2.5	Define the term organisational feasibility.
	A.3.3 Costs and Benefits	A.3.3.1	Describe the main methods used to evaluate an investment, such as Return on Investment, Internal Rate of Return, Net Present Value.
		A.3.3.2	Describe how to evaluate the typical benefits of ICT, both tangible, such as cost reduction, schedule improvements and intangible, such as staff satisfaction, improved company image.
		A.3.3.3	Define and distinguish between capital costs and operational (current) costs.
	A.3.4 Evaluation of ICT Solutions	A.3.4.1	Understand the strategic importance of evaluating all costs and benefits before, during, and after, the delivery of a new solution.

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CATEGORY	TOPIC	REF.	ITEM
		A.3.4.2	Outline the major methods used to evaluate ICT solutions, such as feasibility study, budget and control, return on investment, cost benefit analysis, pilot projects, user surveys.
		A.3.4.3	List examples of costs and benefits that are easy and difficult to measure.
A.4 The Global Networked Economy	*A.4.1 Opportunities from Global Networks*	A.4.1.1	Define the concept of globalisation and the opportunities it can provide for businesses.
		A.4.1.2	Describe the business value of the Internet for commercial organisations.
		A.4.1.3	Outline the use of intranets and extranets in business.
	A.4.2 Transforming Processes to e-Business	A.4.2.1	Outline the major effects of e-business on organisations.
		A.4.2.2	Outline how ICT can be used to drive organisational change.
		A.4.2.3	Outline how to provide effective customer service and manage customer relationships in e-business operations.
	A.4.3 Customer-Centricity and Virtual Organisations	A.4.3.1	Define the concept of a virtual organisation and describe how virtual organisations operate.
		A.4.3.2	Describe how ICT can redefine organisational boundaries and how it can be used to increase organisational flexibility.
		A.4.3.3	Define the unique customer concept and its main technological implications.
	A.4.4 Enterprise Applications	A.4.4.1	Describe the scope and use of Customer Relationship Management systems.
		A.4.4.2	Describe the scope and use of Supply Chain Management systems.
		A.4.4.3	Describe the scope and use of Enterprise Resource Planning systems.

CATEGORY	TOPIC	REF.	ITEM
A.5 Project Management	*A.5.1 IS Projects*	A.5.1.1	Outline how ICT projects differ from other business projects in terms of being agents of change, difficulty in measuring progress, intangibility of ICT outputs, poor understanding of ICT by clients.
		A.5.1.2	Relate the concepts of project management to ICT and IS, including pure development, pure deployment, and mixed projects.
		A.5.1.3	List the major factors that ensure successful IS project management.
		A.5.1.4	List the major factors that hinder successful IS project management.
	A.5.2 Time, Cost and Quality	A.5.2.1	Describe the impact time, cost and quality have on each other and on project management.
		A.5.2.2	List the major factors of uncertainty that affect time, cost and quality of IS projects.
		A.5.2.3	List the most common methods for estimation in different IS project types.
	A.5.3 Project Organisation	A.5.3.1	Describe the principal elements of project organisation, such as work breakdown structure, subcontracting, organisational structure, linear responsibility chart.
		A.5.3.2	Outline the advantages and disadvantages of a highly formal definition of project responsibilities.
		A.5.3.3	Describe the roles involved in an ICT project, such as a steering committee, client/contractor's project manager, specialist, key user, final user.
	A.5.4 Project Planning, Monitoring and Control	A.5.4.1	Understand the structure, content, and purpose of a project plan.
		A.5.4.2	Outline the main objects used in international project management methodologies, such as activities, dependencies, critical path, Gantt chart.

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CATEGORY	TOPIC	REF.	ITEM
		A.5.4.3	List the main functional elements of computer-based project management tools.
		A.5.4.4	Describe the rationale behind earned value analysis and related performance indexes.
		A.5.4.5	Describe the elements of project control, such as activities, resources, deliverables, plans, actual progress.
	A.5.5 Project Evaluation	A.5.5.1	Describe the main concepts of risk management that apply to a project proposal, such as risk assessment, risk control.
		A.5.5.2	Describe the importance of planning assumptions regarding scope, constraints, technical and organisational aspects, and outline how time, cost and quality might be affected by unforeseen factors.
		A.5.5.3	Outline the issues related to project budgeting and cost accounting.
		A.5.5.4	Outline the difficulties in measuring some project benefits.
	A.5.6 Project and Contract Management	A.5.6.1	List the phases of a typical IS project.
		A.5.6.2	Outline the importance of gaining formal agreement on various project documents, including statements of work and contracts.
		A.5.6.3	List the items that should be covered in a contract, such as deliverables, dates, cost, methods, staff expertise, quality assurance, penalties.
		A.5.6.4	Describe the need for milestones, checkpoints, reviews.
		A.5.6.5	Recognise the impact of European public procurement directives on IS procurement.
	A.5.7 Quality Assurance	A.5.7.1	List the benefits derived from quality assurance in IS.

CATEGORY	TOPIC	REF.	ITEM
		A.5.7.2	Outline variables that can be used to measure IS/ICT quality, such as user satisfaction, robustness, security, bug free software.
		A.5.7.3	Distinguish between the roles of a project manager, quality assurance manager and project assurance group within an organisational structure.
		A.5.7.4	List the main categories of software quality analyses, such as static and dynamic testing techniques.
	A.5.8 Innovation of Information Systems	A.5.8.1	Describe the concept of innovation in information systems.
		A.5.8.2	Outline the organisational and managerial challenges in planning and benefiting from innovation.
		A.5.8.3	Recognise environments which foster and develop IS innovation, such as a flat management structure, promoting open communication, encouraging a cross functional team approach, integrating innovation into core business values and processes.
A.6 Collaboration and Communication	A.6.1 Teams	A.6.1.1	Define the concept of groups and teams, and describe their different motivational levels.
		A.6.1.2	Recognise different team roles and distinguish between those involved in creating content as well as supporting the work of the team.
		A.6.1.3	Outline the main challenges of collaboration and co-operation in teams and groups.
	A.6.2 Globally Distributed Teams	A.6.2.1	Describe the business value derived from globally distributed teams.
		A.6.2.2	List typical business functions that can be exploited by globally distributed teams.
		A.6.2.3	Outline the organisational and managerial challenges presented by globally distributed teams.

CATEGORY	TOPIC	REF.	ITEM
	A.6.3 Social Networking	A.6.3.1	Describe social networking technologies and outline their main features.
		A.6.3.2	Recognise business applications of social networking technologies, such as new advertising/marketing strategies, creation of new business networks, more productive collaboration in virtual environments.
		A.6.3.3	Recognise the impact of social networking technologies on the creation of new forms of collaboration and social involvement.
	A.6.4 Presenting the Case for Change	A.6.4.1	Describe the role of effective communication in articulating shared objectives.
		A.6.4.2	List interpersonal communication forms and recognise the need for a common understanding of jargon and ICT terminology.
		A.6.4.3	List motivating factors for the acceptance of new technology.
		A.6.4.4	List the reasons why there might be resistance to change.
	A.6.5 Audio-visual Tools	A.6.5.1	List the most widely used audio-visual (AV) tools.
		A.6.5.2	Outline where AV tools might be used.
		A.6.5.3	Outline the benefits of using AV tools.
		A.6.5.4	List technical requirements for the use of AV tools.
A.7 Legal and Ethical Issues	A.7.1 Intellectual Capital and Property Rights	A.7.1.1	Define the concept of intellectual property.
		A.7.1.2	Recognise common breaches of intellectual property rights.
		A.7.1.3	Outline methods to protect intellectual property rights.
		A.7.1.4	Define ownership of copyright in an ICT context.

CATEGORY	TOPIC	REF.	ITEM
		A.7.1.5	Recognise common breaches of copyright.
		A.7.1.6	Define the term software piracy.
	A.7.2 Legal Issues	A.7.2.1	Outline the main legal issues related to the use of ICT, such as privacy, copyright, software licenses, contracts.
		A.7.2.2	Outline the principles contained in national legislation related to the legal issues in ICT.
		A.7.2.3	Outline the principles contained in EU legislation related to the legal issues in ICT.
	A.7.3 Ethics and Codes of Conduct	A.7.3.1	Outline how all levels of decisions can be considered from an organisational, ethical and moral perspective.
		A.7.3.2	Outline personal and professional privacy issues associated with the use of ICT systems.
		A.7.3.3	List typical topics covered by codes of professional conduct regarding the use and development of ICT systems.
	A.7.4 Security	A.7.4.1	Outline the potential threats to IS and ICT infrastructure.
		A.7.4.2	Identify specific methods and technologies that will protect a system from unlawful, malicious attack and accidental damage.
		A.7.4.3	Describe the scope and function of a security policy.
		A.7.4.4	Outline the role of a security officer.
		A.7.4.5	Distinguish between various levels of security policies and relate them to severity of risk.
		A.7.4.6	Outline appropriate security considerations for a given scenario.

CATEGORY	TOPIC	REF.	ITEM
	A.7.5 Health and Safety	A.7.5.1	Describe the special health and safety (H&S) considerations pertinent to IT use, such as sharp edges, hot surfaces, usage and disposal conditions, waves, electric shocks, cables, screen flicker, repetitive strain injury.
		A.7.5.2	List actions to minimise or eliminate potential H&S hazards.
		A.7.5.3	Outline the central concepts of the relevant EU and national H&S legislation and directives.

MODULE B – "BUILD" KNOWLEDGE AREA
DEVELOPMENT AND INTEGRATION OF INFORMATION SYSTEMS

The following is the Syllabus for Module B, Build, which provides the basis for the tests in this module domain.

Module Goals

**EUCIP CORE:
Build Knowledge Area**

Module B, Build, requires the candidate to understand the development and implementation of Information Systems.

The candidate shall be able to:

- Understand the technical aspects of design, specification, development, testing, integration and deployment of IT systems.
- Understand the systems development life cycle, the typical development process and be aware of recent systems development trends.
- Appreciate the principles and uses of relational databases and data warehouses.
- Understand the relational model and query languages. Be aware of important database administration and security issues.
- Understand software design methods and techniques, describe typical data structures and algorithms and interpret programming constructs. Understand object-oriented programming principles.
- Appreciate programming maintenance issues, and know about documenting and testing software systems.
- Appreciate the design principles associated with user interfaces, web pages and hypermedia. Understand the basic elements of HTML and XML and appreciate different types of web-based programming.

CATEGORY	TOPIC	REF.	ITEM
B.1 Systems Development Process and Methods	*B.1.1 Software in Data Processing Systems*	B.1.1.1	Describe a data processing system as a combination of hardware, firmware, operating system software, application software, system configuration data and user-defined data.
		B.1.1.2	Recognise and list examples of system software.
		B.1.1.3	Recognise and list examples of application software.
	B.1.2 Systems Development Life Cycles	B.1.2.1	Describe the typical phases of systems development.

CATEGORY	TOPIC	REF.	ITEM
		B.1.2.2	Compare the various classical models of systems development life cycle, such as waterfall, spiral, prototyping, incremental releases.
		B.1.2.3	Describe the life cycle of a system in terms of analysis, development and deployment, use and maintenance, decommissioning.
		B.1.2.4	Outline specifications for requirements and design, such as organisational specification, technical specification.
	B.1.3 Software Development Tools	B.1.3.1	Outline the use of tools at different stages of systems development, such as upper, lower, integrated CASE tools.
		B.1.3.2	Outline the strengths and weaknesses of different software development environments.
		B.1.3.3	Outline the use of simple development tools for editing, compiling, testing, debugging software.
	B.1.4 System Testing and Deployment	B.1.4.1	Describe the different types of testing and review that can be applied during the systems development life cycle.
		B.1.4.2	Describe the main issues in the system implementation phase (deployment), such as release of software to users, data migration, user training and initial support.
		B.1.4.3	Outline the strengths and weaknesses of different implementation approaches, such as big bang, step by step, core model and rollouts.
		B.1.4.4	List the typical components of system user manuals and technical reference documents.
	B.1.5 System Control and Safety	B.1.5.1	Distinguish between development, test and production environments and understand the importance of a structured approach to system releases, such as version control systems, software distribution procedures.

CATEGORY	TOPIC	REF.	ITEM
		B.1.5.2	Recognise risks related to system failures and outline measures to protect company-sensitive data at various levels, such as physical, procedural.
		B.1.5.3	Describe the day-to-day security routines in a distributed system, such as back-up procedures, access control.
	B.1.6 Trends in Systems Development	B.1.6.1	Describe standard and innovative approaches and standards for systems development, such as ISO12207, SEI/CMMI, agile methodologies.
		B.1.6.2	Understand the impact of current technical architecture developments, such as two or three-tier client server variants, "n" tier web-based, service oriented architectures, legacy mainframe extension and integration on systems development.
		B.1.6.3	Describe the complexity of modern "system of systems" and approaches to manage this complexity, such as autonomic systems.
B.2 Data Management and Databases	*B.2.1 Data and Transactions*	B.2.1.1	Outline the importance of durable data recording for transaction processing and reporting systems.
		B.2.1.2	Describe how atomicity, consistency, isolation and durability help to guarantee secure database transactions.
		B.2.1.3	Outline design and maintenance issues for multi-user systems, such as data redundancy and inconsistency, integrity problems, flexibility in data, concurrent access and security.
	B.2.2 Database Structure	B.2.2.1	Distinguish between a file management system and a database management system (DBMS).
		B.2.2.2	Describe the components of a database system, such as data files, data dictionary, indexes, statistical data.

CATEGORY	TOPIC	REF.	ITEM
		B.2.2.3	Outline the business areas where a DBMS is used, and recognise the benefits they offer.
		B.2.2.4	Outline the components of a DBMS, such as query language, report generator, administration tools, concurrency controls, transaction management, backup/recovery tools.
		B.2.2.5	Describe the different roles of a database administrator, database designer/programmer, database user.
	B.2.3 Data Modeling	B.2.3.1	Define data abstraction and describe the difference between physical level, conceptual (logical) level, view (user) level.
		B.2.3.2	Distinguish between different groups of data models, such as the object-based logical model, record-based logical model, physical data model.
		B.2.3.3	Describe the principles of record-based logical models, such as hierarchical model, network model.
		B.2.3.4	Describe the principles of object-based logical models, such as entity-relationship model, object-oriented model.
	B.2.4 The Relational Model	B.2.4.1	Outline the benefits of a relational model, such as non-redundancy, flexibility, scalability.
		B.2.4.2	Describe important relational model terms, such as relation, key, primary key, alternate key, foreign key, referential integrity.
		B.2.4.3	Explain through simple examples the process of normalisation for 1st, 2nd, 3rd normal form.
	B.2.5 Query Languages	B.2.5.1	Distinguish between procedural and non-procedural query languages.

CATEGORY	TOPIC	REF.	ITEM
		B.2.5.2	Describe the fundamental operations of relational algebra, such as select, project, rename, cartesian product, union, joins, set difference.
		B.2.5.3	Describe the components of the Structured Query Language (SQL), such as Data Definition Language (DDL), Data Manipulation Language (DML), Data Control Language (DCL).
		B.2.5.4	Understand SQL DDL commands, such as create, drop, alter table.
		B.2.5.5	Understand SQL DCL commands, such as grant, revoke.
	B.2.6 SQL queries	B.2.6.1	Understand basic SQL DML commands, such as insert, delete, update, select.
		B.2.6.2	Understand SQL clauses, such as where, order by, group by.
		B.2.6.3	Outline the use of views and special SQL commands, such as commit, rollback.
	B.2.7 Database Administration and Security	B.2.7.1	Describe the most important database administration procedures, such as schema definition, storage structure and access methods, schema and physical organisation modification, authorisation for data access.
		B.2.7.2	Describe the security and integrity problems covered by the acronym CIA (Confidentiality, Integrity, Availability), such as integrity constraints, accidental loss of data integrity, accidental loss of data consistency, intentional (malicious) access to the database.
		B.2.7.3	Outline examples of different security policies, such as human security, physical security, operating system security, database security.
		B.2.7.4	Describe recovery schemes based on different types of failure, such as logical errors, system errors, system crash, disk failure.

CATEGORY	TOPIC	REF.	ITEM
	B.2.8 Data Warehousing and Data Mining	B.2.8.1	Describe the concept and components of a data warehousing (DW) system.
		B.2.8.2	Define the concept of data mining.
		B.2.8.3	Recognise the principle uses of DW systems.
B.3 Programming	B.3.1 Software Design Methods and Techniques	B.3.1.1	Outline the main features of different program design methods, such as object-oriented (OO) design, top down design, structured programming.
		B.3.1.2	Describe the use of abstraction as a technique for problem-solving and software design.
		B.3.1.3	Outline the specific needs of legacy systems in program design, such as complex structure, poor documentation, obsolete software/hardware, business critical system.
		B.3.1.4	Distinguish between open source and proprietary software development.
		B.3.1.5	Outline the different licensing requirements of proprietary software, open source, free software, freeware.
	B.3.2 Data Structures and Algorithms	B.3.2.1	Describe structured and unstructured data types and recognise different data structures, such as records, arrays, linked lists.
		B.3.2.2	Evaluate the fit between typical search and sort algorithms and the different data structures.
	B.3.3 Programming Languages	B.3.3.1	Distinguish between and describe the merits of the main types of programming languages, such as functional, procedural, OO-based.
		B.3.3.2	Describe the use of procedures and functions, and distinguish between call by value and call by reference.
		B.3.3.3	Define the term syntax and outline its importance in programming languages.

CATEGORY	TOPIC	REF.	ITEM
		B.3.3.4	Distinguish between compilation and interpretation of programming languages.
	B.3.4 Object-Oriented Programming	B.3.4.1	Describe the main concepts of object-oriented design.
		B.3.4.2	Describe the concept of object-oriented programming.
		B.3.4.3	Describe the concept of a class, object, instance, method and their relationship in object-oriented programming.
		B.3.4.4	Describe the concept of inheritance and the impact of inheritance for the programmer.
		B.3.4.5	Describe the concepts of abstraction and encapsulation (information hiding).
		B.3.4.6	Describe how polymorphism contributes to efficient software design through the development of reusable components.
	B.3.5 Elementary Constructs	B.3.5.1	Interpret and evaluate input/output instructions.
		B.3.5.2	Interpret and evaluate control statements.
		B.3.5.3	Interpret and evaluate arithmetic and logical operations.
	B.3.6 Testing	B.3.6.1	Define basic testing concepts, such as error, fault, failure. Recognise the various levels of checking, testing, debugging.
		B.3.6.2	Describe the different purposes and scope of unit testing, system testing, acceptance testing.
		B.3.6.3	Distinguish between static and dynamic test methodologies, and list examples of automatic test tools.
	B.3.7 Documentation and Maintenance	B.3.7.1	Describe the common documentation for software development and delivery, such as structured English, decision trees, Unified Modeling Language (UML) code, code comments, flowcharts.

CATEGORY	TOPIC	REF.	ITEM
		B.3.7.2	Describe the value of well-structured and documented code.
		B.3.7.3	Outline how to document changes in software and program documentation.
		B.3.7.4	Describe methods to attain quality in program maintenance, such as code inspections, rules for comments in the code, technical reference documents.
	B.3.8 Programming Examples	B.3.8.1	Interpret small program segments constructed from a given hypothesis.
		B.3.8.2	Identify errors or weaknesses in the code and modify it to meet requirements.
B.4 User Interface and Web Design	*B.4.1 Human-Computer Interaction: Guidelines and Standards*	B.4.1.1	Define basic concepts of communication theory, such as sender, messages, receiver.
		B.4.1.2	Understand how communication applies to human beings, and recognise effective ways to communicate information.
		B.4.1.3	Define the concept of a User Interface and list the different kinds of interfaces, such as textual, graphical, auditory.
		B.4.1.4	Outline the various technologies that communicate information to human senses, such as sound types, visual clues, digital smells, haptics/touch.
		B.4.1.5	List models for testing the effectiveness of a user interface against its design requirements and goals.
	B.4.2 Graphic Design	B.4.2.1	Outline the concepts of graphics and animation (bitmap and vector), digital audio and video, and describe their differences, uses, standard formats.
		B.4.2.2	Describe the benefits of using drawings, pictures, colours, animation, and apply basic principles of graphic design, such as balance, harmony, contrast, variety.

CATEGORY	TOPIC	REF.	ITEM
		B.4.2.3	Use common tools for simple picture manipulation in terms of size, shape, colours, contrast, transparency.
	B.4.3 Web and Hypermedia: Possibilities and Limitations	B.4.3.1	Describe the history behind the Internet and the World Wide Web.
		B.4.3.2	Define hypertext and hypermedia and outline their importance in web page design.
		B.4.3.3	Outline the common components used in web pages, such as top bar, side bar, site map, contact, search feature, help, last updated, navigation icons.
		B.4.3.4	Describe the use and value of internal and external websites in a company.
		B.4.3.5	Outline some of the challenges in maintaining a business website.
	B.4.4 Web Design Requirements and Methods	B.4.4.1	Recognise the needs of the target group for whom a web page has been designed.
		B.4.4.2	Outline the risks of having too many messages on one page.
		B.4.4.3	Outline the problems associated with a poor mix of colours.
		B.4.4.4	Describe guidelines for developing user-friendly websites, such as readability, prioritised content, easily navigable, consistently navigable, where am I.
		B.4.4.5	Describe general quality criteria for web text, such as browser capability issues, validating HTML, condense text content, spell-check, small byte-size graphics.
		B.4.4.6	Explain the need for easy navigation on a website.
		B.4.4.7	Outline the tools for the development of a website.
		B.4.4.8	Outline the use and purpose of structure diagrams for website design.

CATEGORY	TOPIC	REF.	ITEM
		B.4.4.9	Describe the major methods used for navigation.
		B.4.4.10	Describe some project approaches to web design and common techniques, such as story boards, rough drafts.
	B.4.5 Designing Web Pages	B.4.5.1	Outline the concept of a markup language and describe the main features of HTML.
		B.4.5.2	Use basic HTML commands and interpret layout commands, such as hard format, soft format, special characters, dividers, alignment, headers, image tags, backgrounds, colours, links, lists, tables, forms, frames.
		B.4.5.3	Outline basic graphic principles for normal written text, such as font size, percentage white space.
		B.4.5.4	Outline the basic elements of XML, its uses, the evolution of HTML into XHTML.
		B.4.5.5	Describe the concept of style sheets, such as Cascading Style Sheets (CSS) and Extensible Stylesheet Language (XSL). Understand their use in design.
	B.4.6 Web Based Programming	B.4.6.1	Distinguish between client-side and server-side technologies and recognise different types of web-based programming languages.
		B.4.6.2	List some of the main challenges in integrating web-based systems to existing systems.

MODULE C – "OPERATE" KNOWLEDGE AREA
OPERATION AND SUPPORT OF INFORMATION SYSTEMS

The following is the Syllabus for Module C, Operate, which provides the basis for the tests in this module domain.

Module Goals

EUCIP CORE:
Operate Knowledge Area

Module C, Operate, requires the candidate to appreciate the operation and support of Information Systems.

The candidate shall be able to:

- Understand hardware components, computing architectures and processor concepts.
- Appreciate the principles of operating systems and understand features of common operating systems.
- Understand communications principles, network components and architectures, and communication protocols.
- Understand network service principles including cryptography and the domain name system.
- Understand the World Wide Web, electronic messaging options and voice over Internet protocol services.
- Understand wireless communication principles and wireless networks and protocols.
- Describe network management principles and the simple network management protocol.
- Outline tools for system and network management.
- Appreciate the importance of a client-oriented approach to IT support, and apply some of the basic principles of IT service delivery.

CATEGORY	TOPIC	REF.	ITEM
C.1 Computing Components and Architectures	*C.1.1 Main Hardware*	C.1.1.1	Identify the main central components of a computer system, such as CPU, RAM, ROM, and describe their functions.
		C.1.1.2	Describe the interrelations between the main central components of a computer system.
		C.1.1.3	Identify the main types of peripheral units of a basic computer system, such as screen, keyboard and pointing devices, disks, network cards, printers, and describe their functions.

CATEGORY	TOPIC	REF.	ITEM
		C.1.1.4	Recognise the characteristics of different types of peripheral units and compare features and performance using appropriate parameters, such as capacity, speed, resolution, compatible standards.
		C.1.1.5	Distinguish between the main types of memory technology, such as DRAM, SRAM, EPROM, flash, and compare their uses.
	C.1.2 Computer Architectures	C.1.2.1	Identify, using diagrams, the architecture of a general purpose computer.
		C.1.2.2	Describe the concept of chipset and the purpose of the various types of buses in a computer system.
		C.1.2.3	Describe the concept of memory hierarchy, such as hierarchy levels, faster memory versus slower storage devices, cache efficiency, and its implications in computer systems.
		C.1.2.4	Identify the range of computer systems available, such as handheld, laptop, desktop, multiprocessor servers, mainframes, and outline the main differences in their architectures.
	C.1.3 Processors	C.1.3.1	Describe the concept of an Instruction Set Architecture (ISA).
		C.1.3.2	Describe the dualism between CISC and RISC processor design.
		C.1.3.3	Describe the concepts of instruction pipelining, instruction-level parallelism, dynamic scheduling and speculative execution.
		C.1.3.4	Define the term coprocessor and outline the role of a coprocessor in the ISA.
		C.1.3.5	Describe the features of a microprocessor, such as single/multi-core, clock frequency, pipeline stages, caching system, chip size, power consumption/dissipation.

CATEGORY	TOPIC	REF.	ITEM
C.2 Operating Systems	*C.2.1 Principles*	C.2.1.1	Describe the functions of operating systems (OS) available for a general purpose computer.
		C.2.1.2	Outline different types of OS, such as batch, time-sharing, real-time.
		C.2.1.3	Describe the concept of application programming interface (API) and provide examples of API, such as Java API, Windows API, Google Maps API.
		C.2.1.4	Describe how the resources of a computer are managed by software.
	C.2.2 Concurrent and Parallel Processes	C.2.2.1	Outline the reasons for concurrency inside an OS.
		C.2.2.2	Outline the mutual exclusion problem.
		C.2.2.3	Outline processing and multiprocessing.
		C.2.2.4	Outline threading.
		C.2.2.5	Outline a context switch operation.
	C.2.3 Memory and Storage Management	C.2.3.1	Outline the purpose of virtual memory.
		C.2.3.2	Describe how an OS manages virtual memory through storage and memory hardware.
		C.2.3.3	Describe the concept of thrashing, its impact and how it is prevented and managed.
		C.2.3.4	Describe how the concept of memory hierarchy affects programming, such as separating working memory from files.
		C.2.3.5	Outline the functions of a file system.
	C.2.4 Security and Protection	C.2.4.1	Understand the need for protection and security (in terms of confidentiality, integrity and availability) in a computer system.
		C.2.4.2	Outline the types of protection mechanisms used in OS.

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CATEGORY	TOPIC	REF.	ITEM
		C.2.4.3	Describe the threats associated with malware, such as backdoors, Trojan horses, computer viruses. Outline the main measures against such threats.
		C.2.4.4	Outline the differences between identification and authentication.
		C.2.4.5	Describe authentication techniques and define a "strong" authentication scheme.
		C.2.4.6	Outline the principles of access control.
		C.2.4.7	Outline the need for back-up and recovery.
	C.2.5 Widespread Operating Systems	C.2.5.1	Describe the main features of an OS belonging to the Unix, Linux, Mac family, such as installation, user interface, security, performance, common uses, stability.
		C.2.5.2	Describe the main features of an OS belonging to the Microsoft Windows family, such as installation, user interface, security, performance, common uses, stability.
C.3 Communications and Networks	C.3.1 Communication Principles	C.3.1.1	Distinguish between logical and physical network functionalities.
		C.3.1.2	Describe the principles of information transport defining the signal concept.
		C.3.1.3	Distinguish between analog and digital signals.
		C.3.1.4	Outline the issues in converting signals from analog to digital and vice versa.
		C.3.1.5	Compare circuit switching with packet switching.
		C.3.1.6	Describe the role of network standardisation bodies, such as ITU, IEEE.
	C.3.2 Network Components and Architectures	C.3.2.1	List the components of a network, such as hosts, transmission media, apparatus, and describe their functions.

CATEGORY	TOPIC	REF.	ITEM
		C.3.2.2	Describe the characteristics of transmission media, such as twisted pair, coaxial cable, fiber optic, microwaves.
		C.3.2.3	Describe how the components of a network are connected to each other.
		C.3.2.4	Describe the function of interconnecting devices, such as hub, switch, router, repeater.
		C.3.2.5	Distinguish between the characteristics of LAN and WAN.
		C.3.2.6	Describe different WAN technologies and options, such as dial up, ISDN, DSL, frame relay, leased line.
		C.3.2.7	Describe the standard network topologies and associate them with suitable LAN standards, such as Ethernet, token ring, FDDI.
		C.3.2.8	Outline different media access strategies used in different standards, such as CSMA/CD versus token passing.
		C.3.2.9	Describe the function of a firewall and its importance in network security.
	C.3.3 Communication Protocols	C.3.3.1	Describe the ISO 7-layer reference model and list the services managed by each layer.
		C.3.3.2	Match and relate the TCP/IP model to the ISO reference model.
		C.3.3.3	Describe how a packet is routed over the Internet.
		C.3.3.4	Compare streams and connection-oriented protocols with datagrams and connectionless protocols.
		C.3.3.5	Distinguish between TCP and UDP in terms of reliability versus speed.
C.4 Network Services	C.4.1 Network Security Issues	C.4.1.1	Describe the various types of threats to regular network operations, such as denial of service attack, sniffing, port stealing.

CATEGORY	TOPIC	REF.	ITEM
		C.4.1.2	Define the concepts of spoofing and identity theft, and the related security threats.
	C.4.2 Cryptography	C.4.2.1	Describe the origin of cryptography and its applications in network security.
		C.4.2.2	Distinguish between secret key algorithms and public key algorithms.
		C.4.2.3	Describe how cryptography is used for protecting network communication by enhancing confidentiality (IPSec, SSH and SSL), by enforcing authentication (digital signature), and by creating a virtual private network (VPN).
	C.4.3 Domain Name System	C.4.3.1	Describe the domain name system (DNS) and its scope.
		C.4.3.2	Describe how Internet hosts are named.
		C.4.3.3	Describe the use and purpose of resource descriptors.
		C.4.3.4	Describe Internet Protocol (IP) addressing and how a domain name is translated into an IP address.
	C.4.4 The World Wide Web	C.4.4.1	Describe the World Wide Web (WWW) as a client/server application.
		C.4.4.2	Outline the role of a Web server.
		C.4.4.3	Outline the role of a Web client (browser).
		C.4.4.4	Outline the role and the functions of the hypertext transmission protocol (HTTP).
		C.4.4.5	Define and outline the purpose of a uniform resource locator (URL).
		C.4.4.6	Outline the purpose and use of the common gateway interface (CGI).
		C.4.4.7	Outline the concept of an applet.
		C.4.4.8	Understand how website content can be managed dynamically using a database.

CATEGORY	TOPIC	REF.	ITEM
		C.4.4.9	Outline the options available to host a website, such as running your own web server, sharing a server provided by a hosting provider, using a dedicated server provided by a hosting provider.
	C.4.5 Messaging	C.4.5.1	Compare the various electronic messaging systems, such as e-mail, SMS/MMS, instant messaging, community posts.
		C.4.5.2	Distinguish between e-mail and web-mail applications.
		C.4.5.3	Describe the roles and functions of e-mail clients, servers and gateways.
		C.4.5.4	Describe the simple mail transfer protocol (SMTP), the post office protocol version 3 (POP3), and the internet message access protocol (IMAP).
	C.4.6 Voice over Internet Protocol (VoIP)	C.4.6.1	Describe the concept of IP telephony.
		C.4.6.2	Describe the user and network requirements of VoIP.
	C.4.7 System Infrastructure Dimensioning	C.4.7.1	Describe the impact of data size and data type on network resources, such as resource requirements for plain text and numbers, voice, music, images, motion pictures, combined audio-video transmission.
		C.4.7.2	Describe the characteristics of a server computer system that has to host a multimedia application.
C.5 Wireless and Ubiquitous Computing	C.5.1 Multimedia and Mobile Computing Components	C.5.1.1	Outline some mobile electronic devices, such as smartphones, PDA, GPS, wearable computing components.
		C.5.1.2	Outline the main multimedia input/output devices, such as scanners, digital cameras, microphones, screens, displays, speakers, headphones and understand their uses.

CATEGORY	TOPIC	REF.	ITEM
		C.5.1.3	Describe the major multimedia storage standards, such as CD-ROM, DVD, magneto-optical disk, flash memory, and distinguish between their technical characteristics.
	C.5.2 Principles of Wireless Communication	C.5.2.1	List technologies used for wireless communications and describe their functionality.
		C.5.2.2	Outline the main differences between major wireless standards, such as Bluetooth, IEEE802.11, IEEE802.16 (WiMax).
		C.5.2.3	Outline the limitations and issues associated with wireless and mobile computing, such as coverage, communication speed, compatibility.
	C.5.3 Wireless Networks and Protocols	C.5.3.1	Describe the main components of a wireless LAN (WLAN) and outline their purpose.
		C.5.3.2	Evaluate the compatibility of different WLAN technologies.
		C.5.3.3	Describe the main components of a satellite-based network.
		C.5.3.4	Describe the main characteristics of mobile station protocols, such as mobile IP, WAP, Bluetooth, UMTS.
		C.5.3.5	Outline the range of applicability of each protocol for mobile stations.
		C.5.3.6	Outline the concept of Radio-Frequency Identification (RFID) and its uses, such as passport identification, product tracking, transportation payments, inventory systems.
C.6 Network Management	C.6.1 Principles of Network Management	C.6.1.1	Describe the main functions of a network management system.
		C.6.1.2	Describe the different parameters which can be managed in a network, such as performance, failures, configuration settings.
		C.6.1.3	Compare different system architectures for network management.

CATEGORY	TOPIC	REF.	ITEM
	C.6.2 Simple Network Management Protocol	C.6.2.1	Describe the main components of the simple network management protocol (SNMP) and their interaction.
		C.6.2.2	Describe the main services provided by the SNMP.
		C.6.2.3	Outline the main limitations of the SNMP.
	C.6.3 System and Network Management Tools	C.6.3.1	Describe the differences between a system management tool and a network management tool.
		C.6.3.2	Outline some of the widely used software tools for system management and for network management, such as ping, traceroute, tcpdump, HP Software, Tivoli NetView, Solstice, OpenNMS.
		C.6.3.3	Outline the infrastructure requirements for operating a network management tool.
C.7 Service Delivery and Support	C.7.1 Customer Relationships and Service Level Agreements	C.7.1.1	Describe the service level management process and identify its benefits.
		C.7.1.2	List and describe the main elements of a Service Level Agreement (SLA), such as definition of services, performance measurement, problem management, IPR and confidential information, warranties, termination.
		C.7.1.3	Compare the uses and purposes of SLA, underpinning contracts and operational level agreements.
	C.7.2 Capacity and Contingency Planning	C.7.2.1	Describe capacity management and explain the importance of the three sub-processes of business, service, and component.
		C.7.2.2	Identify the purpose and main elements of a capacity plan.
		C.7.2.3	Outline the concepts of risk, threat and vulnerability and give examples of each in an IS context such as loss of service, data loss.

CATEGORY	TOPIC	REF.	ITEM
		C.7.2.4	List examples of risk reduction measures.
		C.7.2.5	Outline the purpose and main elements of a contingency/service continuity plan, such as fault tolerance, restart procedures, staffing, alternative resources, back up.
	C.7.3 Availability Management	C.7.3.1	Outline the purpose and benefits of availability management and define the concepts of availability, reliability, failure, recovery.
		C.7.3.2	Compare some of the commonly-used measures of availability, such as percentage availability, frequency of failure, mean time between failures, impact of failure.
		C.7.3.3	Outline availability management methods and techniques, such as component failure impact analysis (CFIA), fault tree analysis (FTA).
	C.7.4 Service Desk	C.7.4.1	Outline the purpose of a service desk in a service support organisation.
		C.7.4.2	Identify the different types of service desk and describe the circumstances in which each is appropriate.
		C.7.4.3	Define the main elements of an incident management system.
	C.7.5 Change Management	C.7.5.1	Describe best practices in managing the configuration of an IT infrastructure.
		C.7.5.2	Describe best practices in IT change and release management.
		C.7.5.3	Define the purpose of a change request and the essential elements that it should contain.

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Glossary of Syllabus Item Verbs

In order to assist in the interpretation of the *depth* and *breadth* of a syllabus item, the EUCIP Core Syllabus Version 3.0 was developed to ensure that there is maximum clarity around these aspects of each syllabus item.

To meet this objective for the breadth of an item, the development team, involving Subject Matter Experts from across Europe, ensured that each item was constructed using examples (such as…) and clear and concise terminology.

In addition, to assist courseware developers, trainers, and learning providers in understanding the appropriate depth of each syllabus item, a description of action verbs used in the syllabus has been provided. In the table below, the verbs used in the syllabus have been mapped to a particular cognitive level from Bloom's taxonomy of educational objectives[2] to give an indication of the level of complexity and depth of knowledge attributed to the item. This table, when combined with a strong understanding of the knowledge and skills covered by the domain, can assist in developing appropriate training materials and lesson plans.

Bloom's Taxonomy Levels relevant to the content of the EUCIP Core Syllabus Version 3.0 are:

Knowledge: The ability to remember previously learned information.
Comprehension: The ability to grasp the meaning of information.
Application: The ability to apply knowledge to actual situations.
Analysis: The ability to separate an idea into constituent parts and to understand how these parts relate.
Evaluation: The ability to judge ideas or methods using internal evidence or external criteria.

ACTION VERB	COGNITIVE LEVEL	DESCRIPTION	EXAMPLE
List	*Knowledge*	Be able to compile a complete set of elements making up a concept/object/term, or recognise this complete set.	List the advantages and disadvantages of e-learning. (A.1.8.3)
Define	*Knowledge*	Be able to provide a dictionary or textbook definition of a concept or term by referring to its key attributes.	Define the term digital divide. (A.1.9.3)
Outline	*Knowledge*	Be able to provide a brief description of concept/object/term, or recognise a definition from a non-definition.	Outline how different organisational cultures impact on ICT policies. (A.1.1.5)
Recognise/ Identify	*Knowledge/ Comprehension*	Be able to identify an attribute of a concept from non-attributes. Implies a selective use of knowledge.	Describe the different roles of a database administrator, database designer/programmer and database user. (B.2.2.5)

[2] Bloom B. S. (1956). Taxonomy of Educational Objectives, Handbook I: The Cognitive Domain. New York: David McKay Co Inc.

ACTION VERB	COGNITIVE LEVEL	DESCRIPTION	EXAMPLE
Describe	*Knowledge*	Be able to provide a description of a concept/object/term, or recognise a definition from a non-definition. Describe will usually require a short paragraph instead of a single sentence.	Describe the use of information processing systems within an organisation... (A.1.2.3)
Understand	*Comprehension*	Be able to comprehend the meaning or purpose of concepts, contexts, objects. Infers a requirement for both a broad and deep coverage of an area.	Understand the strategic importance of evaluating all costs and benefits before, during, and after, the delivery of a new solution. (A.3.4.1)
Explain	*Comprehension*	Be able to articulate the nature and purpose of concept/object/term.	Explain the need for easy navigation on a website. (B.4.4.6)
Interpret	*Application*	Be able to translate information from observation, charts, tables, graphs, code, and written material in a verifiable manner.	Interpret and evaluate input/output instructions. (B.3.5.1)
Use	*Application*	Be able to implement specific methods.	Use basic HTML commands and interpret layout commands… (B.4.5.2)
Relate/Match and relate	*Application*	Be able to apply knowledge to actual situations.	Match and relate the TCP/IP model to the ISO reference model. (C.3.3.2)
Compare	*Analysis*	Be able to identify the similarities/differences between methods or options (the opposite of distinguish).	Compare circuit switching with packet switching. (C.3.1.5)
Distinguish	*Analysis*	Be able to identify the differences between methods, options, lists. You can only distinguish between things, so any question will consist of two or more elements.	Distinguish between virtual teamworking and physical, co-located teamworking. (A.1.7.3)
Differentiate	*Analysis*	Be able to break down objects or ideas into simpler parts and see how the parts relate and are organised.	Outline the difference between data and information. (A.1.2.1)
Evaluate	*Evaluation*	Be able to classify objects, situations, people, conditions, etc., according to defined criteria of quality. Indication of quality must be given in the defined criteria of each class category.	Evaluate the compatibility of different WLAN technologies. (C.5.3.2)