



European Quality Assurance Network for Informatics Education

## **Programme Outcomes for Accreditation**

Programme Outcomes can be described as quality standards for knowledge, skills and competences that graduates of an accredited course should have achieved as the educational base for practising their profession or for post-graduate studies. They will vary in extent and intensity in accordance with the differing objectives of First and Second Cycle degree (FCD and SCD) programmes. In the Euro-Inf Framework they are arranged into the following six categories:

- Underlying Conceptual Basis for Informatics
- Analysis
- Design and Implementation
- Economic, Legal, Social, Ethical and Environmental context
- Informatics Practice
- Other Professional Competences

A wide range of degree programmes fall within the general area of informatics but all graduates should be aware of the wider spectrum of informatics and of the underlying concepts relevant to their programmes of study. The first category “Underlying Conceptual Basis for Informatics” therefore identifies capabilities that are essential to satisfying the other programme outcomes, independently from the specific informatics specialisation and application context.

“Analysis” involves the application of informatics concepts and tools to the analysis of both problems and their solutions, while “Design and Implementation” involve the creation and development of an economically viable product, process or system to meet a defined need. It involves significant technical and intellectual challenges and can be used to integrate informatics knowledge and skills to the solution of real and complex problems.

Computing activity can have impacts on individuals, on commerce, on society and on the environment. The “Economic, legal, social, ethical and environmental context” category identifies the skills that graduates need to manage their activities and to be aware of the various legal and ethical constraints under which they are expected to operate, including an understanding of the need for a high level of professional and ethical conduct in relation to activities in informatics and a knowledge of professional codes of conduct.

“Informatics practice” identifies the practical capabilities that graduates should have demonstrated through the application of informatics skills in a variety of situations. They should have demonstrated that they have an understanding of the contexts in which informatics knowledge can be applied (e.g. development and application of hardware and software, operation and management of informatics systems, etc).

Social or soft competences, listed under the category “Other Professional Competences” are crucial to communicate information, ideas, problems and solutions. Besides the so-called soft skills, the category also includes personal organisational skills, team working and life-long learning.

The same arrangement of categories is maintained for the programme outcomes of Second Cycle Degree (SCD) programmes. They apply in addition to the competences described for graduates of FCD programmes. Although all six outcome categories are used to describe expected outcomes of both FC and SC programmes, there are important differences in the requirements at the two levels.

These differences in the levels of First and Second Cycle accredited informatics programmes should inform the interpretation of the programme outcomes by HEIs and by auditing teams. For instance, whereas First Cycle graduates should be able to formalise and specify real-world problems whose solution involves the use of informatics, Second Cycle graduates are, in addition, expected to have demonstrated their ability to specify and complete informatics tasks that are complex, incompletely defined or unfamiliar.

No restriction is implied or intended by this document in the design of programmes to meet the specified programme outcomes. For example, the requirements of more than one outcome could be satisfied within a single module or unit such as individual or group project work. Similarly, it is possible that some programmes are designed such that the requirements of the Other Professional Competences category are taught and assessed entirely within modules or units designed to satisfy the requirements of other outcomes, whereas in other programmes the Other Professional Competences requirements are taught and assessed in modules or units designed specifically for this purpose.

### **Terminology**

Within this document the words **awareness** and **complex** have following meanings.

- **Awareness:** for some of the topics included in these outcomes, graduates need to have some familiarity with the topic and to know why it is important within the general context of informatics, but not necessarily in-depth knowledge of that topic.
- **Complex:** problems, artefacts or systems that are complex involve dealing simultaneously with a sizeable number of factors that interact and require deep understanding, in relation both to their analysis and to their design and implementation.

## **Outcomes for First Cycle Degree (FCD) Programmes**

### **Underlying Conceptual Basis for Informatics**

Graduates of a First Cycle degree should be able to:

- describe and explain the essential facts, concepts, theories and mathematical methods relevant to computing, computing equipment, computer communication and informatics applications as appropriate to their programme of study
- outline the characteristics of relevant state-of-the-art hardware and software and their practical application
- outline relevant historical and current developments in informatics and show insight into possible future trends and developments
- apply and integrate knowledge and understanding of other informatics disciplines in support of study in their own specialist area(s)
- demonstrate awareness of the need for deep domain knowledge when creating informatics applications in other subject areas

### **Analysis**

Graduates of a First Cycle degree should be able to:

- use a range of techniques to identify the requirements of real-world problems, analyse their complexity and assess the feasibility of their solution using informatics techniques
- describe a problem and its solution at varying levels of abstraction
- select and use relevant analytic, modelling and simulation methods
- choose appropriate solution patterns, algorithms and data structures
- analyse the extent to which an informatics system meets the criteria defined for its current use and future development

### **Design and Implementation**

Graduates of a First Cycle degree should be able to:

- specify and design computing/network hardware/software which meet specified requirements
- describe the phases involved in different life cycle models used for specifying, building, testing and commissioning new systems and for maintaining existing systems
- select and use appropriate process models, programming environments and data management techniques for projects involving traditional applications as well as emerging application areas
- describe and explain the design of systems and interfaces for human-computer and computer-computer interaction
- apply relevant practical and programming skills to the creation of computer programs and/or other informatics artefacts

### **Economic, legal, social, ethical and environmental context**

Graduates of a First Cycle degree should be able to:

- demonstrate awareness of the need for a high level of professional and ethical conduct in informatics and a knowledge of professional codes of conduct
- explain how commercial, industrial, economic and social contexts affect informatics practice
- identify relevant legal requirements governing informatics activities, including data protection, intellectual property rights, contracts, product safety and liability issues, personnel issues and health & safety
- explain the importance of information privacy and security issues in relation to the design, development, maintenance, monitoring and use of informatics-based systems

### **Informatics practice**

Graduates of a First Cycle degree should be able to:

- demonstrate an awareness of appropriate codes of practice and industry standards
- describe and explain management techniques appropriate to the design, implementation, testing, deployment and maintenance of informatics systems, including project management, configuration management, change management, etc., and including relevant automated techniques
- identify risk issues, including security, health & safety, environmental and commercial risk, and explain risk assessment, risk reduction and risk management techniques
- undertake literature searches and reviews using databases and other sources of information
- design and conduct appropriate practical investigations (e.g. of system performance), to interpret data and draw conclusions

### **Other Professional Skills and Competences**

Graduates of a First Cycle degree should be able to:

- organise their own work independently, demonstrate initiative and exercise personal responsibility
- communicate effectively both verbally and using a variety of communications media to a variety of different audiences
- plan self-learning and improve personal performance as a foundation for lifelong learning and ongoing professional development
- identify different ways of organising teams and the various roles within a team
- participate effectively in informatics group-working

## **Outcomes for Second Cycle Degree (SCD) Programmes**

### **Underlying Conceptual Basis for Informatics**

Graduates of a Second Cycle degree should be able to:

- demonstrate either deepened knowledge of a chosen specialisation or broadened knowledge of informatics in general
- explain in depth relevant concepts and scientific principles appropriate to their programme of study, some of which may be from outside informatics
- demonstrate awareness of topics at the forefront of their specialisation and evaluate their significance

### **Analysis**

Graduates of a Second Cycle degree should be able to:

- apply appropriate analysis methods to the solution of complex problems in informatics and to assess their limitations
- use fundamental knowledge to investigate new and emerging technologies and methodologies
- collect and analyse research data and use appropriate analysis tools in tackling unfamiliar problems, such as those with uncertain or incomplete data or specifications, by the appropriate innovation, use or adaptation of analytical methods.

### **Design and Implementation**

Graduates of a Second Cycle degree should be able to:

- describe and explain design processes and methodologies relevant to their subject area and be able to apply and adapt them in unfamiliar situations
- specify and complete informatics tasks that are complex, incompletely defined or unfamiliar
- apply state-of-the-art or innovative methods in problem solving, possibly involving the use of other disciplines
- demonstrate that they can think creatively to develop new and original designs, approaches, methods, *etc*

### **Economic, legal, social, ethical and environmental context**

Graduates of a Second Cycle degree should be able to:

- demonstrate awareness of the need for a high level of professional and ethical conduct in informatics
- identify relevant legal, commercial, industrial, economic and/or social contexts appropriate to their area of study and explain their relevance
- evaluate risk and information security issues relevant to their area of study

### **Informatics practice**

Graduates of a Second Cycle degree should be able to:

- describe and explain applicable techniques and methods for their particular area of study and identify their limitations
- apply informatics techniques to new application areas, taking account of relevant commercial, industrial, social and environmental constraints
- contribute to the further development of informatics

### **Other Professional Competences**

Graduates of a Second Cycle degree should be able to

- organise their own work independently, demonstrating initiative and exercising personal responsibility
- appreciate the skills required to work with and lead a team that may be composed of people from different disciplines and different levels of qualification

*Euro-Inf Framework Standards and Accreditation Criteria for Informatics Programmes  
New Programme Outcomes, as of 12.10.2015*

- undertake literature searches and reviews using databases and other sources of information
- communicate effectively both verbally and using a variety of communications media to a variety of different audiences and preferably also in a second language
- plan self-learning and improve personal performance as a foundation for lifelong learning and ongoing professional development