



UNIVERSITETI I EVROPËS JUGLINDORE  
УНИВЕРЗИТЕТ НА ЈУГОИСТОЧНА ЕВРОПА  
SOUTH EAST EUROPEAN UNIVERSITY

## Study program **Computer Sciences (2017/2018)**

Faculty	Contemporary Sciences and Technologies
Study Cycle	Second Cycle (Postgraduate)
ECTS	60
Title	Master of Computer Sciences - Field: Software and Application Development
Accreditation archive number [60]	03-1619/9
Decision for starting of the program	03-1619/13 (29.09.2017)
Accreditation date	10.07.2017

## Description of the program

The objectives of the study programme are:

- To respond to the global market needs for software and application development with particular emphasis on regional needs and specific perspectives of the Republic of Macedonia towards building a common European educational, employment and research space;
- To prepare students for current and future technological challenges in ICT areas by developing the skills of critical thinking necessary for creativity, ethics and efficiency in a wide range of contexts;
- To train students to approach the information needs of an organization to implement new technologies and discover innovative solutions to business and research programs;
- To prepare students for further academic or research careers;

## Career

The programme will enable students with the necessary knowledge and skills to contribute in all aspects of the software development process, including planning, collaboration, specifications, design, development, delivery and maintenance of software products. In addition, students will also acquire general skills, such as analytical and critical thinking, team work and work in multicultural environments, planning and organizing.

After finishing this programme, the graduates will have career opportunities in a variety of industries, mainly fulfilling needs for computer systems design, such as software developer, software tester, manager of software projects and processes. The last semester of studies includes master thesis writing, enabling program graduates to continue their studies towards a doctoral degree in computer sciences.

## Learning outcomes

### Knowledge and understanding

Advanced knowledge and understanding in the field of software and application development, including:

- Software development, needs analysis, design, coding, testing;
- Programming languages, their analysis and use in the development of various software solutions, software system analysis,

development of Internet applications and security, networking;

- Knowledge of advanced concepts in computer science.
- Managing large software projects.

### **Applying knowledge and understanding**

- Can apply, use, develop and deploy advanced software systems.
- Can offer and apply different methods and methodologies of software development for delivery of major IT solutions.
- Can use various tools for software development and program them using shell, scripts and compiled programs in standalone or web environments.
- Can participate in the process of solving problems in new, unseen or unknown environments for software development in an original, critical and creative way.
- Is able to organize software systems in order to solve various social, economic and/or technological issues.
- Is able to participate in research projects as a base for further academic development.
- Demonstrates expertise in addressing real problems in the field of software development and project management.
- Can develop and apply original and creative ideas.

### **Making judgement**

- Can in an adequate way collect, analyze and evaluate data using modern tools and systems for certain social, economic and/or organizational issues.
- Is able to adequately assess the required deadlines, resources and risks in the planning, development, deployment and maintenance of software, using appropriate tools.
- Can argue and explain ideas, concepts.
- Can test, assess and appropriately decide on various possible IT solutions.

### **Communication skills**

- Can in a clear and unambiguous way communicate their knowledge, data and results of studies to team members, customers, managers and other stakeholders in software development.
- Can adequately adjust the style and form of expression when addressing unskilled audience.
- Can initiate, lead and take responsibility for the work of a group of people.
- Is able to undertake preparations for research and contribute in the field of software development.

### **Learning skills**

- Can follow new developments in the field of software and application development, learn new technologies and implement them.
- Can identify their needs and directions of personal and autonomous development.

## **List of courses**

### **Semester 1**

- [MCS-101] [6.0 ECTS] **Advanced Databases**
- [MCS-102] [6.0 ECTS] **Object-Oriented Design and Programming**
- [MCS-303] [6.0 ECTS] **Research Methodologies**
- [6.0 ECTS] **Elective course**
- [6.0 ECTS] **Free elective course**

### **Semester 2**

- [SAD-200] [24.0 ECTS] **Master Thesis**
- [6.0 ECTS] **Elective course**

## **Description of courses**

### **Core courses**

- **Advanced Databases**

The course aims are to continue with an in-depth study of databases. The course is a continuation of the same course from the first study cycle; it starts with some revision of the conceptual database design models (a well-known entity relationship model) and continues with the enhanced entity relationship model. The concept of normalization and normal forms is introduced and is used for database design. The course continues with data storage methods, representing data elements, database system architecture, query processing and optimization, transaction processing concepts, concurrency control techniques, database recovery techniques and database security and authorization.

- **Object-Oriented Design and Programming**

This course aims to teach a rigorous approach to object-oriented design and programming, with an emphasis on abstraction, modularity, and code reuse as applied to the building and understanding of large-scale systems. In addition to object-oriented concepts, it covers object-oriented modeling using UML, best design practices, design patterns, and their application to real world problem solving and modeling of applications.

- **Research Methodologies**

The purpose of this course is to provide students with knowledge and understanding of different scientific theories and methodologies. Initially the student will be introduced to the conceptual, theoretical definitions and examples of all existing methods of research, hypothesis, direct and indirect variables, validation of the results, the conclusions BIAS and scientific qualitative and quantitative methodologies, "ground research" methodology and other methodological approaches. In each chapter the student will work on practical assignments. After completing the course the student will be able to explain thoroughly and understand the importance of basic scientific concepts, effectively search and find information-relevant literature, identify, describe and formulate scientific problems, make a careful choice of alternative research approaches, thoroughly described, compare and explain the advantages and disadvantages of different scientific methods for collecting quantitative and qualitative data, apply basic scientific methods to analyze quantitative and qualitative data, understand different frameworks for building theory and review and evaluate scientific publications.

- **Master Thesis**

This module enables students to transfer their skills and knowledge to research and carry out more complex tasks related to their master thesis. The module is designed to be fully practical and students to acquire the necessary knowledge and skills to approach writing the thesis. The module has unique return result-to enable students to write the master thesis with minimal difficulties, and with maximum efficiency. The course aims to improve research techniques and style of writing the paper, taking into account the prevention of the usage of illegal means, such as plagiarism and infringement of copyright, which are prohibited by the Statute of SEEU.

## Elective courses

- **Advanced Software Engineering**

The aim of this course is to provide students with knowledge and understanding of advanced software engineering concepts. Initially the students will be introduced to the construction of a clear specification. In addition, the aim is to answer the following advanced aspects of software engineering: What key technical activities are conducted during the clean room software engineering process? How is component-based software engineering used to create systems from reusable components? How does the client/server architecture affect the way in which software is engineered? Are software engineering concepts and principles applicable for Web-based applications and products?

- **Software Development for Mobile Devices**

The aim of the course is to provide students with knowledge and understanding of a pragmatic process for developing applications for mobile devices. It will cover the development aspects for mobile devices, and practical individual project work in design and development oriented towards real practical case for one or more contemporary platforms that will enable students to gain real life practical experience and insights.

- **Interactive Systems Design for Web and Mobile Applications**

The objective of this course is to help students learn the design principles of web and mobile applications in order to achieve high level of usability. More specifically, students will get acquainted with the user-centered design method, which represents the design of mobile applications based on user analysis and the context of use. Additionally, various wire-framing methods of building web and mobile application will be learned, which will be implemented to ensure the usability of the application by the users. Through practical examples, students will learn to avoid designing

bad interfaces and instead develop usable and desirable web and mobile interfaces.

- **Cloud Computing Technologies**

This course covers a series of current cloud computing technologies. The students will learn how to develop Cloud-based software applications on top of various Cloud platforms, how to integrate application-level services built on heterogeneous Cloud platforms, and how to leverage SaaS and PaaS solutions to build comprehensive end-to-end business solutions on the Cloud. For different layers of the cloud technologies, practical solutions such as Google, Amazon, Microsoft, Salesforce.com, etc. as well as theoretical solutions (covered by a set of papers) will be introduced.

- **Web Engineering**

The Web has become a major delivery platform for resources. The aim of this course is to address concepts, methods, technologies and techniques to developing high quality, reliable and usable web applications. The course explores the approaches, methodologies, techniques and tools that support their design, development, evolution and evaluation. Students will be able to learn Web engineering methods and techniques that incorporate unique aspects of the problem domain such as: document oriented delivery, fine-grained lifecycles, user-centric development, client-server legacy system integration and diverse end user skill levels that ensure proper operability, maintenance and security of a web application.

- **Data Visualization**

The aim of this course is to introduce students to the field of data visualization. Students will learn visualization design and evaluation principles, and learn how to acquire, parse, and analyze large datasets. Students will also learn techniques for visualizing multivariate, temporal, text-based, geospatial, hierarchical, and network/graph-based data. Additionally, students will utilize Processing, D3, R and ggplot2, and many other tools to prototype many of these techniques on existing datasets.

- **Service Oriented Architectures**

The aim of this course is to establish an in-depth study of Service Oriented Architectures (SOA) from three main perspectives: business, architectural and technological point of view. From business perspective, adopting SOA is essential to delivering business agility; therefore, the importance of SOA in industry will be explained. The architectural perspective will discuss different architectural models of software development, with focus on SOA design and design patterns. The technology perspective will provide students with the opportunity to gain the required experience to implement and deploy SOA solutions that will meet different functional and non-functional requirements.

- **Internet of Things**

This course provides a general introduction to the emerging concept of the "Internet of Things" and an overview of its stack of enabling technologies, spanning from sensors and actuators near the user or environment end to the cyber-physical systems that provide governing intelligence, via the Cloud that caters for virtually ubiquitous connectivity. This course brings together the next two big things, Semantic Web (Web 3.0) and the Internet of Things. The course emphasizes software-hardware code sign. A student may choose to focus on either software, hardware, or both aspects. The course aims at highlighting open issues with the Internet of Things (IoT) model, deployment, evaluation and evolution, outlining future directions relevant for societal impact and research opportunities.

- **Data Intensive Computing**

Modern computing applications require storage, management and processing of petabytes of data. The data are not only extremely diverse, ranging from unstructured text and relational tables to complex graphs, but it is also dynamic. Storing that large amount of data and extract knowledge from large datasets needs new techniques and technologies. This course focuses on developing scalable architectures, algorithms and techniques for supporting various data intensive computation. During this course student will be introduced to infrastructures for data-intensive computing, with a focus on abstractions, frameworks, and algorithms that allow developers to distribute computations across many machines. Topics include core concepts (partitioning, replication, locality, consistency), computational models (MapReduce, dataflow, stream processing, bulk-synchronous parallel), and applications.

- **Advanced Data Structures and Algorithms**

This course builds on previous knowledge in the area of algorithms and data structures. The goal of the course is to acquaint students with efficient advanced algorithms and adequate data structures that are used to organize, search and optimize data. It also includes the theoretical efficiency of algorithms and its practical determination with in order to be able to compare different algorithms. During the course, students will be introduced to several well-known algorithms, particularly search and optimization in complex nonlinear structures such as trees and graphs.

- **Knowledge Engineering**

The knowledge contained in the World Wide Web is available in interlinked documents written in a natural language. To make use of this knowledge, technologies such as natural language processing, information retrieval, data and knowledge mining must be applied. Semantic Web technologies follow an alternative approach by complementing web documents with explicit semantics based on formal knowledge representations, such as, e.g. ontology. The aim of this subject is to learn the fundamentals of Semantic Web technologies and how they are applied for knowledge representation in the World Wide Web. Students will get insight on how to represent knowledge with ontology and how to access and benefit from semantic data on the Web. Furthermore, the focus will be on how to make use of Linked Data and the Web of Data, currently the most popular applications based on Semantic Web technologies.

- **Big Data Analytics**

Nowadays the data is produced in massive amounts by new acquisition techniques, large network sensors, social networks, various simulations and utilization of different information systems. Turning such large datasets into useful knowledge requires a new generation of scalable algorithms and data management techniques. Therefore, the aim of this module is to explore key data analysis and management techniques which when applied to big datasets are the keystone to new scientific discoveries at large scale, to the business intelligence in Web and enable real-time decision making in distributed environments. By providing balanced view of theory and practice, the course should allow students to understand, use and build big data analytics and management systems.

- **Database Programming**

Databases provide a convenient means of storing large amounts of data, allowing it to be sorted, searched, viewed, and manipulated according to the business needs and goals. This course is designed to develop SQL programming proficiency. Emphasis is placed on data definition, data manipulation, and data control statements as well as on report generation. Structured Query Language (SQL) and PL/SQL (Procedural Language/SQL) are covered. Oracle Developer application development utilities and tools will be used to create and manipulate with databases (in Oracle database management system). Topics include data definition and manipulation languages, stored procedures, triggers, indexing techniques, and elementary query optimization.

- **Web Application Security**

This class is designed to teach students how to properly secure a web server, web page, and web application. Students will take an already existing web application and redesign it to be as secure as possible. Students will also design and build an ecommerce site designed with the best security practices. Students will learn how to protect confidential information, including financial and personal data. Part of security is testing the security and vulnerabilities of the web application. To that end, students will also learn the common techniques for penetrating web applications and web servers. This will give students the techniques to properly test their web applications in their academic and professional careers

- **Software Testing and Analysis**

Software plays an important role in our daily activities, often providing critical services to end users. It is important to ensure that these systems function as they are intended with a high degree of quality. Software testing and program analysis are two techniques that are widely used to ensure the software quality. These techniques are used by developers in order to validate, verify, and evaluate the quality of software produced during the software engineering process. This course aims to provide students with advanced knowledge of the techniques used in software testing and program analysis. Students will gain an understanding of the concepts and theories that underlie these techniques. Students will also learn to use existing popular tools that support testing and analysis tasks and will be exposed to new research in the area.

- **Software Quality Assurance and Risk Management**

As software becomes more complex, and in order to ensure a higher quality, it is necessary to establish clear processes and methodologies. Doing so will ensure that the end-product has been exposed to intensive and rigorous industry-wide verification and validation techniques and procedures. Additionally, it is necessary to provide good management of risks in order to ensure reliable processes. This will translate into a high degree of assurance that a software system passes the test for correctness and reliability. The aim of this course is to provide theoretical and practical knowledge about both the quality assurance processes and risk management.

- **Wireless Mobile Networks**

The course introduces the underlying concepts and principles of wireless networks. It presents the different components of a network and how these components fit together. It is intended to help students to understand the wireless mobile network technologies in general, and wireless LAN (WLAN) technology in depth and to help students prepare for the CWNA certification exam (PW0-100). The CWNA certification prepares the candidate to implement,

troubleshoot, and maintain small, medium, and large wireless networks.

- **Rhetoric**

During its long history of 2,500 years, rhetoric was used to indicate many different things; but rhetoric nowadays is considered as the art of persuasion through language. Rhetoric marks the way that an individual is linked to a particular theme or idea in order to convince the others. Rhetoric is characterized by several distinguishing features.

- **Multilingualism and multiculturalism**

The purpose of this subject will be multilingualism in multicultural societies as a social phenomenon. This phenomenon is massive in the world. During the lectures, more precise terms such as monoculturalism and multiculturalism will be considered. The term 'linguistic nationalism' has at least two forms of this nationalism, which collide with each other: for the leaders of the most powerful countries nationalism means expansion, and for minorities it takes the form of defiance and struggle for the affirmation of identity, despite such pressure. The emphasis during the program will be multiculturalism in education. In the schools curricula consists of contents from different cultures.

- **Selected Advanced Topics in IT Applications for Preparing a Scientific Paper**

The aim of this subject is: To display the technical elements, the structure of the text and design of a scientific research. To enable students to acquire advanced knowledge and skills from selected advanced chapters of IT applications that will be needed in preparing the scientific and research paper. Practical application of these objectives in preparing student's individual research paper.

- **Selected Advanced Topics in Applications for Statistical Data Processing**

The aim of this subject is: To display the technical elements in the field of statistics: organizing, processing, comparing through analysis and publication of data. To enable students to acquire advanced knowledge and skills from selected advanced chapters of the applications for statistical data processing. Practical application of these objectives in statistical processing of data obtained from questionnaires, reports, scientific studies and other documents.

- **Professional Communication**

The course is focused on the development of those communication skills that are essential for effective functioning in the professional world. Students will study the process for analysis of different communication situations, and will accordingly comprehend them. Among the themes that will be covered are communication in organization, interpersonal and group communication, oral presentations, interviews for employment, professional business letters and interpersonal skills including group dynamics and teamwork.

- **Labor Market**

The main aim of the course "Labor Market" is to provide second cycle students with basic and in-depth knowledge in the field of labor market theory and the mechanism of functioning of the market economy. The objective of the course Labor Market is to provide and teach students about categories, laws and basic principles through which the labor market functions. The course makes a detailed analysis of behavior pattern and the role that key agents play in labor market: individuals, companies and government. The analysis is based on two basic categories - labor demand and labor supply, which are applied in almost all the topics that are addressed in this course. The knowledge gained by the students from this course, serves as essential theoretical basis necessary to understand and grasp the different theories and policies that are applied in the labor market. The course teaches students to understand how labor markets distribute and use efficiently the rare factor of production- the labor. Lectures include knowledge about the concepts of labor demand and labor supply and their practical application; behavior of individuals in the labor market, in order to maximize their usefulness; behavior of companies in the labor market, aiming profit maximization; government's role in the labor market, the different structures of labor markets: labor market in full competition, monopoly in the labor market, the role of unions in the labor market, the bilateral monopoly in the labor market. Lectures and class discussions cover material that may not be in the book and some aspects of the material contained in the basic literature will not be discussed in class, but are left for active studying of the student. Therefore in order the student to achieve success in learning the course is to be present in lectures and workshops by participating actively in the discussion of various issues related to labor market.

- **Methodology of Teaching**

The aim of the course is to introduce the students to the basic teaching approaches and methods. They are expected to gain knowledge and skills in order to be able to apply the active educational tools. The course also offers development, learning and teaching as concepts and basic practices that allow teachers to teach about the development of thinking. Throughout this course, students will gain both theoretical background and entirety of

strategies that will enable them to reflect and develop both their own and their students' critical thinking.

- **Philosophy of Social Sciences**

This module covers information that will provide the learner to gain knowledge, skill and competence of the social sciences, including general methodology (explaining, theorizing, testing), the application of philosophy (especially individualism versus holism), the nature of rationality, and the history of theories and concepts. This module offers an advanced survey of current debates about the ontology, methodology, and aims of the social sciences. It will focus on the central issues of the social sciences: Ethno methodology; Evolution; Phenomenology; Rationality; Relativism; Scientific Methods; Textual Interpretations. Learning outcomes: On successful completion of the course, students will be able to: Understand the goal of social sciences. Tell the difference between explaining and understanding human behavior; To explain the different approach in explanation of the social sciences compare the natural sciences, the peculiarities about human beings and social phenomena; To understand the social structures, practices, norms, institutions, etc. The relationship between individuals and larger social structures; To explain the rely not only on facts about individuals and their mental states, but also the cases in which social phenomena cannot be explained in terms of individual behavior; To understand the value-laden in a different way or to a different degree than natural science, the possibility to have a value-free social science, the possibility to have an objectivity in social science.

- **Project Management**

On successful completion of the course, students will be able to: plan the activities necessary to implement the project, identify their interdependencies, their duration and costs; prepare the necessary reports and perform all the required communication between the project and the client, as well as among the team members and the other stakeholders. structure the project to its constituent activities; prepare a Gantt-chart and a network plan for the project and identify the shortest time needed to complete the project; use MS Project as a tool in the process of planning, implementation and review of the project; define the project, identify its scope and objectives and develop project specification;

- **Optimization Methods**

The aim of this course is to present techniques of modeling and optimization in order to prepare students for developing their ability to prepare models for solving real problems in the field of computer science. The course explore the importance of matrix factorizations as an important tool which offers modality for optimizing the solutions of different numerical algorithms which are of basic interest for problem solving in the area computer sciences. The course introduces optimization theory and approach to find the optimum. The different methods of optimization will be analyzed such as the simplex method, duality problem and sensitivity of the problems of linear programming. The aim is to explore a computer implementation for each of the problems followed by the proposal of the corresponding model for optimization.

- **Ethical and Legal Issues in Information Technology (IT)**

Aims of the course program: to develop an understanding of the relationship between computing, technological change, society and the law; to emphasize the powerful role that computers and computer professionals play in a technological society; to provide an understanding of legal areas which are relevant to the discipline of computing; to provide an understanding of ethical concepts that are important to computer users and professionals; to provide experience in the consideration of ethical matters and the resolution of ethical dilemmas.

- **Protection of Human Rights**

The purpose of this course is: to introduce students with the concept of international law on human rights, their implementation, influence of those rights in the creation of national policies; to encourage students to critically reflect on the relationship between international law and national law; make them aware of current international events, how they affect the daily lives of people in the world; encourage students to contribute in matters of drafting laws for the protection of human rights hoping that, the law makers will consult them same during the creation and implementation of state policies.

- **Web Data Mining for Business Intelligence**

An in-depth study of the knowledge discovery process and its applications in Web mining, Web analytics and business intelligence. The course provides coverage of various aspects of data collection and preprocessing, as well as basic data mining techniques for segmentation, classification, predictive modeling, association analysis, and sequential pattern discovery. The primary focus of the course is the application of these techniques to Web analytics, user behavior modeling, e-metrics for business intelligence, Web personalization and recommender systems. Also addressed are privacy and ethical issues related to Web data mining. The emphasis of the course will be on data gathering and practical usefulness.

