### Specification for the book of courses

<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
<td>Computer Systems Security</td>
</tr>
<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Computer Network Security</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Milovanović I. Emina, Ćirić M. Vladimir</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Dimitrijević M. Aleksandar, Predić B. Bratislav</td>
</tr>
<tr>
<td>Lecturer/associate (for OFE)</td>
<td></td>
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<tr>
<td>Number of ECTS</td>
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</tbody>
</table>

#### Course status (obligatory/elective)
- elective

#### Prerequisites
The aim of the course is for the students to gain insight into the potential security weaknesses and obtain the basic knowledge to enhance the security, as well as to gain the knowledge and skills to apply security techniques in order to increase the security of computer networks.

#### Course objectives
It is expected for the students to be able to analyse the security aspects of computer networks, and to be able to plan the strategy to increase security. It is also expected that the student has a knowledge to use tools, as well as to implement security protocols in order to increase security of the network.

#### Course outline

#### Theoretical teaching

#### Practical teaching (exercises, OFE, study and research work)

#### Textbooks/references

#### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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<tbody>
<tr>
<td>2</td>
<td>1</td>
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</tbody>
</table>

#### Teaching methods
Lectures. Lab. exercises. Homeworks, and projects, student seminars (presentation and discussion of students’ work).

#### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
<td>10</td>
<td>written exam</td>
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<tr>
<td>exercises</td>
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<td>oral exam</td>
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<td>colloquia</td>
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<tr>
<td>projects</td>
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**Study program**  
Computing and Informatics

**Module**  
Computer Systems Security

**Type and level of studies**  
MSc

**The name of the course**  
System Administration

**Lecturer (for lectures)**  
Janković S. Dragan, Tokić I. Teufik

**Lecturer/associate (for exercises)**  
Stanimirović S. Aleksandar

**Lecturer/associate (for OFE)**  

<table>
<thead>
<tr>
<th>Number of ECTS</th>
<th>4</th>
<th>Course status (obligatory/elective)</th>
<th>Elective</th>
</tr>
</thead>
</table>

**Prerequisites**

**Course objectives**
Introductory course to system administration covering Windows, Linux and Unix operating systems as well as basic procedures in technical support process

**Course outcomes**
Upon completion of the course the student should be able to administer the system running the operating systems Windows, Linux and Unix.

**Course outline**

**Theoretical teaching**

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux operating system:</td>
<td>Linux operating system / Ubuntu Server, Comparison to Windows Server, Operating system exposure, Server configuration - config files, Monitoring server - Log files.</td>
</tr>
<tr>
<td>Unix operating system:</td>
<td>Unix operating system - Solaris 10, Comparison to Windows server and Ubuntu Server, Unix reliability, Operating system configuration, Basic use cases and attack resiliance, Basises of Technical Support: Technical Support basic principles, Workflows - Level 1, Level 2, Level 3 and management level, Ticketing systems, Technical support agent metrics, Remote location support</td>
</tr>
</tbody>
</table>

**Practical teaching (exercises, OFE, study and research work)**

<table>
<thead>
<tr>
<th>Windows labs:</th>
<th>Server 2012 installation (core and GUI), Roles and Features - Installing and configuring Active Directory, Group policy creation, Creation and deployment of GPO’s.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linux labs:</td>
<td>Ubuntu server installation, Basic services configuration, Enabling and configuring SSH, Monitoring log files, Unix labs: Solaris 10 installation, Configuration of basic services, Activation of tunnel SSH session from another Linux/Unix/OS X station, Technical support labs: Creating RDC session, Creating VNC, Session- Encrypting VNC Desktop sharing session (Join.me)</td>
</tr>
</tbody>
</table>

**Textbooks/references**

4. Lectures in the form of Power Point presentations
5. 

**Number of classes of active education per week during semester/trimester/year**

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<thead>
<tr>
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</table>

**Teaching methods**

Lectures, Auditive exercises, Laboratory exercises, remote access to the virtual machines

**Grade (maximum number of points 100)**

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
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<tbody>
<tr>
<td>activity during lectures</td>
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<td>exercises</td>
<td>15 oral exam</td>
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<td>Type and level of studies</td>
<td>MSc</td>
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<tr>
<td>The name of the course</td>
<td>Secure Software Design and Implementation</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Janković S. Dragan, Tošić B. Milorad</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Rajković J. Petar</td>
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<td>Lecturer/associate (for OFE)</td>
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<td>Number of ECTS</td>
<td>4 Course status (obligatory/elective) Elective</td>
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</tbody>
</table>

**Prerequisites**

**Course objectives**
The main course objective is introducing students with basic concepts and applied techniques used for secure code development.

**Course outcomes**
The students have to be able to identify the main problems related to software solutions security and to apply learned resolution techniques.

**Course outline**

**Theoretical teaching**


**Practical teaching (exercises, OFE, study and research work)**


**Textbooks/references**


**Number of classes of active education per week during semester/trimester/year**

<table>
<thead>
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</table>

**Teaching methods**

Lectures, Auditive exercises, Laboratory exercises

**Grade (maximum number of points 100)**

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<td>Digital Forensics</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Tokić I. Teufik, Rančić D. Dejan</td>
<td></td>
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<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Dimitrijević M. Aleksandar</td>
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<td>Number of ECTS</td>
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<td>Course status (obligatory/elective)</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>Introduction to the process of identification, preservation and analysis of digital evidence, as well as preparing them for presentation in a court of proper forensic procedure on the correct way.</td>
<td></td>
</tr>
<tr>
<td>Course objectives</td>
<td>Theoretical and practical knowledge of the process of identification, preservation and analysis of digital evidence. Knowledge of software and hardware tools for digital forensics. Knowledge of the legal components of digital forensics. Knowledge of basic principles, policies and methodologies of digital forensics.</td>
<td></td>
</tr>
<tr>
<td>Theoretical teaching</td>
<td>Getting to know the software and hardware tools for digital forensics</td>
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<td>Practical teaching (exercises, OFE, study and research work)</td>
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<td>Textbooks/references</td>
<td>1 Rančić Dejan, Tokić Teufik, Power Point presentations, 2013.</td>
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<td>Other classes</td>
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<tr>
<td>Teaching methods</td>
<td>Lectures, exercises, individual student work on projects.</td>
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<td>Grade (maximum number of points 100)</td>
<td>Pre-exam duties</td>
<td>points</td>
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<td>projects</td>
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<th>Computing and Informatics</th>
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<tbody>
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<td>Module</td>
<td>Computer engineering</td>
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</tr>
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<td>The name of the course</td>
<td>Cloud Computing</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stojanović M. Natalija, Ćirić M. Vladimir</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Stojanović M. Natalija, Ćirić M. Vladimir</td>
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<tr>
<td>Lecturer/associate (for OFE)</td>
<td>Stojanović M. Natalija, Ćirić M. Vladimir</td>
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</tr>
<tr>
<td>Course status (obligatory/elective)</td>
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</tr>
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</table>

**Prerequisites**

- The goal of this course is to give an insight to the students into the concepts of virtualization and cloud systems, as well as insight into service-oriented principles.

**Course objectives**

- It is expected for the students to acquire the knowledge needed to plan, design and implement virtual and cloud service system, as well as to implement virtualization concepts based on the solutions offered by different vendors. Students will also acquire the necessary theoretical and practical skills to develop applications on cloud computing.

**Course outline**


**Theoretical teaching**


**Textbooks/references**


**Number of classes of active education per week during semester/trimester/year**

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
</tr>
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<tbody>
<tr>
<td>2</td>
<td>1</td>
<td></td>
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</tbody>
</table>

**Teaching methods**

- Lectures, exercises, lab exercises.

**Grade (maximum number of points 100)**

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>Points</th>
<th>Final exam</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
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<td>written exam</td>
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<tr>
<td>projects</td>
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</table>
### Course Outline

**Theoretical teaching**

1. Introduction  
2. Passwords  
3. Pseudorandom numbers  
4. Pseudorandom generators  
5. Buffer Overflow  
6. Safety increase techniques  
7. Shared resources deadlock problems  
8. Input validation  
9. Cryptography  
10. Authentication protocols  
11. Software configurability  
12. Processing sensitive data  
13. Memory management

**Practical teaching (exercises, OFE, study and research work)**

1. Weak points in shell scripts  
2. Password coding  
3. Pseudorandom numbers based applications  
4. Implementation of random generators  
5. Methods for the Buffer Overflow problem overcoming  
6. Access control matrix implementation  
7. Thread management  
8. Methods against file level deadlocks  
9. Input validation  
10. Authentication protocols  
11. Using cryptographic algorithms in software  
12. Configurations - design and using  
13. Problems with memory allocation and de-allocation

### Textbooks/References

4. Lectures in a form of Power Point presentations
5.  

### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
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<tr>
<td>2</td>
<td>1</td>
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</tbody>
</table>

### Teaching methods

Lectures, Auditive exercises, Laboratory exercises, using of LMS and distance hypervisor access.

### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
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<td>projects</td>
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<td>Computer Systems Security</td>
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<td>Type and level of studies</td>
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</tr>
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<td>The name of the course</td>
<td>Computational Psychology</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stanković V. Vladimir</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Stanković V. Vladimir</td>
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<tr>
<td>Course status (obligatory/elective)</td>
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</tr>
</tbody>
</table>

**Prerequisites**

**Course objectives**

- Introduction with the basics of computational psychology and the possibilities of applying computing in contemporary psychology.

**Course outcomes**

- The students will get to know the basics of computational psychology and obtain the needed knowledge for application and system development which may be applied in the contemporary psychology.

**Course outline**

**Theoretical teaching**


**Practical teaching (exercises, OFE, study and research work)**

- Developing/Superstructure of a computational model or a computer/microcomputer/cell-phone/smartphone etc. application from the field of computational psychology.

**Textbooks/references**

4. [additional references]

**Number of classes of active education per week during semester/trimester/year**

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
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<td>2</td>
<td>1</td>
<td></td>
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<td></td>
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</tbody>
</table>

**Teaching methods**

- Lectures, exercises, consulting, individual or group project labour

**Grade (maximum number of points 100)**

<table>
<thead>
<tr>
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<th>Final exam</th>
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</tr>
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<td>projects</td>
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<td>MSc</td>
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<tr>
<td>The name of the course</td>
<td>Multimedia Content Analysis</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stanković M. Milena</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Jovanović D. Martin</td>
</tr>
<tr>
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<td>Number of ECTS</td>
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</tr>
<tr>
<td><strong>Prerequisites</strong></td>
<td></td>
</tr>
<tr>
<td>Course objectives</td>
<td>The main objective of the course is to provide students with theoretical and practical knowledge in the field of multimedia content analysis, including speech analysis, image analysis and analysis of the video material, for applications in security systems.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>Students will learn about the main characteristics of the speech signal and the techniques for the speech analysis. They will gain knowledge in the field of image analysis, including segmentation for classification of images and classification based on the colors and spectral parameters of images and videos.</td>
</tr>
<tr>
<td><strong>Teaching methods</strong></td>
<td></td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>The realization of algorithms for speech and image analysis in MATLAB. Projects in the field of speech, photos, videos analysis.</td>
</tr>
<tr>
<td><strong>Textbooks/references</strong></td>
<td></td>
</tr>
<tr>
<td>2 Teaching materials on the site: <a href="http://cs.elfak.ni.ac.rs/nastava/">http://cs.elfak.ni.ac.rs/nastava/</a></td>
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<td><strong>Lectures</strong></td>
<td>Exercises</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>Teaching methods</strong></td>
<td>Lectures by use of slides and interactive work on the computer. Seminars and projects.</td>
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<tr>
<td><strong>Grade (maximum number of points 100)</strong></td>
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<tr>
<td>Pre-exam duties</td>
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<td>projects</td>
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<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Management of IT Resources and Services</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Milentijević Z. Ivan</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Vojinović M. Oliver</td>
</tr>
<tr>
<td>Lecturer/associate (for OFE)</td>
<td></td>
</tr>
<tr>
<td>Number of ECTS</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Prerequisites

Course objectives

To enable students to acquire knowledge about the role of computer resources and services in companies, and about the providing of high-quality and reliable IT services.

Course outcomes

After the course, students will be able to organize IT resources within the specific organization, as well as to plan providing of IT services.

### Course outline

**Theoretical teaching**

IT resources management, management methods and systems. Criteria and requirements for IT resources and services in the organization (the required functionality, quality, safety, performance, cost). Capacity planning of IT resources, technical, operation and budget planning. Capacity control: methods and tools for control of technical aspects (capacity and performance of networks, servers, workstations, software licenses, human resources). Information security, operational procedures, standards and tools for information security. Operational and IT risk and compliance with regulatory requirements. IT control and audit, process level standardization: CMMI, ITIL, PSP/TSP and others. IT service life cycle, service management, planning and management in the multiservice environment.

**Practical teaching (exercises, OFE, study and research work)**

IT resources and services requirement development (collecting, organizing and analyzing requirements). Capacity planning of IT resources, service planning, IT budget planning - capital, service costs and amortization. Testing and performance control of IT resources – tools and methodologies. Examples and templates of standard operating procedures. Tools for testing information security. The process of IT audit, external and internal audit, examples of standards.

### Textbooks/references


### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Teaching methods

Lectures, auditive exercises, homework, team projects.

### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
<td>10</td>
<td>written exam</td>
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<tr>
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<td>50</td>
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<td>colloquia</td>
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</tr>
<tr>
<td>projects</td>
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### Specification for the book of courses

<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
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<tbody>
<tr>
<td>Module</td>
<td>Computer Systems Security</td>
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<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Cryptography</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Rančić D. Dejan, Vučković V. Vladan</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Dimitrijević M. Aleksandar</td>
</tr>
<tr>
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</tr>
<tr>
<td>Course status (obligatory/elective)</td>
<td>elective</td>
</tr>
<tr>
<td>Prerequisites</td>
<td></td>
</tr>
<tr>
<td>Course objectives</td>
<td>Introduction to the field of cryptography in terms of basic principles, algorithms and standards.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>Students will gain knowledge on basic principles, algorithms, and standards used in the field of cryptography. They will also learn how to apply that knowledge in real-world applications.</td>
</tr>
<tr>
<td>Course outline</td>
<td></td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Practical work on the programming cryptographic elements using OpenSSL library.</td>
</tr>
<tr>
<td>Textbooks/references</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><a href="http://www.openssl.org/">http://www.openssl.org/</a></td>
</tr>
<tr>
<td>4</td>
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<td>Number of classes of active education per week during semester/trimester/year</td>
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<td>Exercises</td>
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<td>1</td>
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<tr>
<td>Teaching methods</td>
<td>Lectures, exercises, individual student work on projects.</td>
</tr>
<tr>
<td>Grade (maximum number of points 100)</td>
<td></td>
</tr>
<tr>
<td>Pre-exam duties</td>
<td>points</td>
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<td>projects</td>
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</table>
## Specification for the book of courses

### Study program
Computing and Informatics

### Module
Information systems

### Type and level of studies
MSc

### The name of the course
Semantic Web

### Lecturer (for lectures)
Tošić B. Milorad

### Lecturer/associate (for exercises)
Bogdanović D. Miloš

### Course status (obligatory/elective)
elective

### Course outline

#### Course objectives
The acquisition of basic theoretical knowledge and possible areas of application for the Semantic Web. Conquering the basic programming techniques for developing semantic web applications in the current stage of technology development. Building creative attitudes towards the possible directions for further development of technology in this area.

#### Course outcomes
Developed and adopted a systematic approach to Semantic Web applications in current areas of application. Conquered the theoretical knowledge of the semantics of the information technology. Students know what they are and are able to effectively work with ontologies, and apply them to the attraction applications currently on the web.

#### Theoretical teaching
Introduction: structure, syntax and semantics; need for semantics on the Web. Meta-programming: Metadata, XML Schema, XSLT, RDF. Semantics: The semantics and knowledge, Ontologies, Logic; conclusion; modeling domain; context. Distributed Knowledge: Classification; protocols based on knowledge; Technologies: Tools for working with ontologies; software (API) for working with ontologies, OWL, Methodologies: Methodologies for ontology engineering methodologies of the introduction of knowledge management, semantic systems development methodology; semantic systems: semantic Web Services and semantic Web Portals, Semantic Wiki, Semantic Multi-agent systems, Semantic Web browsers, ... Applications: Web Search, document management systems, bioinformatics, information retrieval, information aggregation, ...

#### Practical teaching (exercises, OFE, study and research work)

#### Textbooks/References
1. Web site with materials for lectures and exercises, Books in English, Materials available on the Internet
2. 
3. 
4. 
5. 

### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
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</tbody>
</table>

### Teaching methods
Lectures, Auditorial exercises, Laboratory exercises; Consultations, Independent students’ research; students’ oral presentation to the selected / given topics; Active students’ participation in the classroom using an interactive course Web site

### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>Final exam</th>
<th>points</th>
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</thead>
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<tr>
<td>activity during lectures</td>
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<tr>
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<td>oral exam</td>
<td>20</td>
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<td>colloquia</td>
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<tr>
<td>projects</td>
<td>project defense</td>
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# Specification for the book of courses

<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
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</thead>
<tbody>
<tr>
<td>Module</td>
<td>Information systems</td>
</tr>
<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Electronic Business</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stojanović H. Dragan</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Predić B. Bratislav</td>
</tr>
<tr>
<td>Number of ECTS</td>
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</table>

| Course status (obligatory/elective) | elective |

<table>
<thead>
<tr>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course objectives</td>
</tr>
<tr>
<td>Course outcomes</td>
</tr>
</tbody>
</table>

## Course outline

### Theoretical teaching


### Practical teaching (exercises, OFE, study and research work)

Work on design and implementation of e-business systems based on implementation of design and architecture patterns of e-business applications using commercial and open-source software components, frameworks and platforms. Implementation of Web-based e-business application using J2EE platform. Implementation of e-business application integration and management of legacy applications using commercial and open-source software components, middleware platforms and frameworks. Implementation and integration of Web service for e-business system integration.

## Textbooks/references

5. Scientific papers and articles presented at conferences and published in journals and books.

## Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
</tr>
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<tr>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

## Teaching methods

Lectures, auditive exercises, lab practicing, independent student work on assignments and projects, student seminars.

## Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>oral exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
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<td>exercises</td>
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<td>oral exam</td>
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<td>colloquia</td>
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</table>
### Specification for the book of courses

<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
<td>Information Systems</td>
</tr>
<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Command and Control Information Systems</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Rančić D. Dejan, Milosavljević Lj. Aleksandar</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Predić B. Bratislav</td>
</tr>
<tr>
<td>Number of ECTS</td>
<td>4 Course status (obligatory/elective) elective</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>Introduction to the basic characteristics and application areas of command &amp; control information systems. Learning how participate in the process of design, development, implementation, operation and maintenance of command &amp; control information systems.</td>
</tr>
<tr>
<td>Course objectives</td>
<td>Theoretical and practical knowledge of the command &amp; control information systems. Capability to program and use existing command &amp; control information systems. Mastering the basics of the theory and techniques of communication in command &amp; control information systems. Mastering fundamentals of the analysis and security of command &amp; control information systems.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>Theoretical and practical knowledge of the command &amp; control information systems. Capability to program and use existing command &amp; control information systems. Mastering the basics of the theory and techniques of communication in command &amp; control information systems. Mastering fundamentals of the analysis and security of command &amp; control information systems.</td>
</tr>
<tr>
<td>Theoretical teaching</td>
<td>Practical implementation of some parts of command &amp; control systems.</td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Practical implementation of some parts of command &amp; control systems.</td>
</tr>
<tr>
<td>Textbooks/references</td>
<td>1 Dejan Rančić, Aleksandar Milosavljević, Slides from lectures (CD), Faculty of Electronic Engineering, Niš, 2013.</td>
</tr>
<tr>
<td></td>
<td>3 Committee To Review Dod C4i Plans And Programs, Realizing The Potential Of C4i: Fundamental Challenges, National Academy Press, 1999.</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Number of classes of active education per week during semester/trimester/year</td>
<td>Lectures, exercises, individual student work on projects.</td>
</tr>
<tr>
<td>Lectures</td>
<td>Exercises</td>
</tr>
<tr>
<td></td>
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<tr>
<td>Teaching methods</td>
<td>Lectures, exercises, individual student work on projects.</td>
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<tr>
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<td></td>
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<tr>
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<td>exercises 50</td>
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<td>projects</td>
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### Specification for the book of courses

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<tr>
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<tbody>
<tr>
<td>Module</td>
<td>Information systems</td>
</tr>
<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Business Information Systems Architectures</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Tošić B. Milorad</td>
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<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Nejković M. Valentina</td>
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<td>Lecturer/associate (for OFE)</td>
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<tr>
<td>Prerequisites</td>
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</tr>
<tr>
<td>Course objectives</td>
<td>Acquisition of practical knowledge and skills in the design and selection of existing solutions, implementation and management of information systems in business systems.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td></td>
</tr>
<tr>
<td>Course outline</td>
<td></td>
</tr>
<tr>
<td>Theoretical teaching</td>
<td>Service-oriented architectures, software environments for development and design of business information systems architecture (Enterprise Architecture Frameworks), Monitoring and metrics for infrastructure and business processes, Green Computing, Virtualization of storage and systems, the role of open source software, Total cost of ownership and return on investment, Software as a service, Content Management, Emerging technologies.</td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
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<tr>
<td>Textbooks/references</td>
<td>1 Web site with materials for lectures and exercises, Books in English, Materials available on the Internet</td>
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<tr>
<td>Number of classes of active education per week during semester/trimester/year</td>
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<td>Exercises</td>
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<td></td>
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<tr>
<td>Teaching methods</td>
<td>Lectures, Auditorial exercises, Laboratory exercises; Consultations, Independent students’ research; students’ oral presentation to the selected / given topics; Active students’ participation in the classroom using an interactive course Web site</td>
</tr>
<tr>
<td>Grade (maximum number of points 100)</td>
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<td>activity during lectures</td>
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<td>colloquia</td>
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<td>projects</td>
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</table>
### Study program
Computing and Informatics

### Module
Information systems

### Type and level of studies
MSc

### The name of the course
Medical Information Systems

### Lecturer (for lectures)
Janković S. Dragan

### Lecturer/associate (for exercises)
Rajković J. Petar

### Course status (obligatory/elective)
Elective

### Prerequisites
The course objectives are introducing students in specifiticies of medical information system development, deployment and project management. The students will get the knowledge about different types of medical software as well as related standards and legislature.

### Course objectives
After the course completion, the students will be able to participate in medical information system development process using theoretical and practical knowledge obtained through lectures and software project development.

### Course outcomes

<table>
<thead>
<tr>
<th>Number of ECTS</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Textbooks/references</td>
<td></td>
</tr>
</tbody>
</table>
5. Lectures in a form of Power Point presentations

### Textbooks/references

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>courses</th>
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### Grade (maximum number of points 100)

<table>
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<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Teaching methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures, Auditive exercises, Laboratory exercises. Student project realization.</td>
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</tbody>
</table>

### Grade (maximum number of points 100)
### Specification for the book of courses

<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
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<tbody>
<tr>
<td>Module</td>
<td>Information Systems</td>
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<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Advanced Learning Technologies</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Milentijević Z. Ivan, Stanković M. Milena</td>
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<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Vojinović M. Oliver</td>
</tr>
<tr>
<td>Course status (obligatory/elective)</td>
<td>elective</td>
</tr>
<tr>
<td>Prerequisites</td>
<td></td>
</tr>
<tr>
<td>Course objectives</td>
<td>To enable students to: acquire knowledge about advanced approaches to learning and education, learn about the possibilities to apply information technologies in order to enhance learning, and learn pedagogical and cognitive effects of applied technology.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>After successfully passing the course the student will be able to analyze the specific educational objectives and the environment, and to design technology environment to support learning.</td>
</tr>
<tr>
<td>Course outline</td>
<td></td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Analysis of learning approaches, analysis of educational objectives, setting of educational environment and mapping to appropriate technology. Design and development of software resources to support learning.</td>
</tr>
<tr>
<td>Textbooks/references</td>
<td></td>
</tr>
<tr>
<td>Number of classes of active education per week during semester/trimester/year</td>
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<td>Exercises</td>
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<td>1</td>
</tr>
<tr>
<td>Teaching methods</td>
<td>Lectures, auditive exercises, lab practicing</td>
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<tr>
<td>Grade (maximum number of points 100)</td>
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</tr>
<tr>
<td>Pre-exam duties</td>
<td>points</td>
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<td>activity during lectures</td>
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<td>colloquia</td>
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</tr>
<tr>
<td>projects</td>
<td>40</td>
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</tbody>
</table>
### Course status
Obligatory/elective: elective

### Prerequisites
Gaining practical programming skills, theoretical knowledge and systematic approach required for the design, implementation and operation of systems in which information technologies, computers, the Internet, and humans act in concert to achieve results that are characterized as intelligent.

### Course objectives
Students are able to identify areas of usage, specific problems and relevant theoretical concepts needed to solve them, possess practical programming skills needed to implement specific examples of usage.

### Course outcomes

### Course outline
Lectures, Auditorial exercises, Laboratory exercises; Consultations, Independent students’ research; students’ oral presentation to the selected / given topics; Active students’ participation in the classroom using an interactive course Web site

### Textbooks/references
1. Web site with materials for lectures and exercises, Books in English, Materials available on the Internet
2. 
3. 
4. 
5. 

### Number of classes of active education per week during semester/trimester/year
<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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<tbody>
<tr>
<td>2</td>
<td>1</td>
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</table>

### Teaching methods
Lectures, Auditorial exercises, Laboratory exercises; Consultations, Independent students’ research; students’ oral presentation to the selected / given topics; Active students’ participation in the classroom using an interactive course Web site

### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
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<tr>
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<table>
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<tr>
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<tbody>
<tr>
<td>Module</td>
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</tr>
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</tr>
<tr>
<td>The name of the course</td>
<td>Systems for Large-scale Data Processing</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
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</tr>
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<tr>
<td>Course status (obligatory/elective)</td>
<td>elective</td>
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</table>

### Prerequisites
- Theoretical and practical knowledge about principles, methods, technologies, software tools, components and platforms for design and implementation of systems for large-scale data processing and analysis.

### Course objectives
- Acquiring knowledge, methods and technologies for design and implementation of systems for large-scale data processing and analysis.

### Course outcomes
- Theoretical and practical knowledge about principles, methods, technologies, software tools, components and platforms for design and implementation of systems for large-scale data processing and analysis.

### Course outline
- Fundamental principles of processing, search and analysis of large-scale data (Big Data). Mobile, parallel and distributed databases and distributed query and transaction processing. NoSQL databases. Data stream and complex event management and processing systems. Cloud computing and large-scale data processing in cloud. Map/Reduce programming framework, Hadoop and related technologies for distributed processing of large-scale data. Data management in sensor networks. Analysis, design and implementation of systems for large-scale data processing. Applications based on systems for large-scale data processing.

### Theoretical teaching
- Work on design and implementation of components and system for large-scale data search, processing and analysis and evaluation of such system on real massive dataset and actual application domains over the set of lab exercise and practical project.

### Practical teaching (exercises, OFE, study and research work)
- Lectures, auditive exercises, lab practicing, independent student work on assignments and projects, student seminars.

### Textbooks/references
5. Scientific papers and articles presented at conferences and published in journals and books.

### Number of classes of active education per week during semester/trimester/year

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<thead>
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<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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### Grade (maximum number of points 100)

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<tr>
<td>Type and level of studies</td>
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</tr>
<tr>
<td>The name of the course</td>
<td>Application of Computers in Defense and Security</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Rančić D. Dejan, Milosavljević Lj. Aleksandar</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Predić B. Bratislav</td>
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<td>Lecturer/associate (for OFE)</td>
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</tr>
<tr>
<td>Number of ECTS</td>
<td>4 elective</td>
</tr>
</tbody>
</table>

#### Prerequisites

- Course objectives
  - Introduction to the basic characteristics and application areas of computing in the field of defense and security.
- Course outcomes
  - Theoretical and practical knowledge on the application of computing in the field of defense and security.

### Course outline

#### Theoretical teaching


#### Practical teaching (exercises, OFE, study and research work)

- Practical implementation of parts of computer systems for application in the field of defense and security.

### Textbooks/references

1. Dejan Rančić, Aleksandar Milosavljević, Slides from lectures (CD), Faculty of Electronic Engineering, Niš, 2013.
4.                          
5.                          

### Number of classes of active education per week during semester/trimester/year

- Lectures: 2
- Exercises: 1
- OFE: 0
- Study and research work: 0
- Other classes: 0

### Grade (maximum number of points 100)

#### Pre-exam duties

- activity during lectures: 10 points
- exercises: 50 points
- colloquia: 0 points
- projects: 0 points

#### Final exam duties

- written exam: 50 points
- oral exam: 40 points

#### Final grade

- Overall grade: 100 points
### Specification for the book of courses

<table>
<thead>
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<th>Study program</th>
<th>Computing and Informatics</th>
</tr>
</thead>
<tbody>
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<td>Module</td>
<td>Information systems</td>
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<td>Type and level of studies</td>
<td>MSc</td>
</tr>
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<td>The name of the course</td>
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</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Janković S. Dragan</td>
</tr>
<tr>
<td>Lecturer/associate (for OFE)</td>
<td>Stanimirović S. Aleksandar</td>
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<td>Lecturer/associate (for exercises)</td>
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<thead>
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<th>Course status (obligatory/elective)</th>
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</table>

<table>
<thead>
<tr>
<th>Prerequisites</th>
</tr>
</thead>
</table>

| Course objectives | Introduce students to the principles on which is based the business intelligence, with its importance in the world and in our country. Getting started with the existing tools for the development of BI analytics, as well as a way of developing it. |
|------------------|

| Course outcomes | After completion of the course, students will be able to do the extraction, transformation, and import data as well as to understand OLAP cubes on the lowest (physical) level, and to develop OLAP cubes in at least one commercial and one non-commercial development environment. Students will learn to write MDX query language. |
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<table>
<thead>
<tr>
<th>Course outline</th>
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</table>

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| Practical teaching (exercises, OFE, study and research work) | Practical work in the two development environments: commercial development environment Microsoft Business Intelligence Studio and noncommercial environment Pentaho Open Source (Data Integration, Mondrian, Design Studio - Eclipse). Practical work on the development of OLAP cubes and BI analytics to end users. |
|---------------------|

<table>
<thead>
<tr>
<th>Textbooks/references</th>
</tr>
</thead>
</table>

| 1 | Turban Sharda, Delen King, Business Intelligence: A managerial Approach, Prentice Hall, 2011. |
| 2 | Gordon Linoff, Michael Berry, Data mining techniques for marketing, sales, and customer relationship management, Wiley, 2011. |
| 3 | N. Balaban, Ž. Ristić, Business Intelligence, (in serbian), Faculty of Economics, Subotica, 2006. |
| 4 | Lectures in a form of Power Point presentations |
| 5 | |

<table>
<thead>
<tr>
<th>Number of classes of active education per week during semester/trimester/year</th>
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</thead>
</table>

<table>
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<th>Study and research work</th>
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<tbody>
<tr>
<td>2</td>
<td>1</td>
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</tbody>
</table>

| Teaching methods | Lectures, Auditive exercises, Laboratory exercises. Student project realization. |
|------------------|

<table>
<thead>
<tr>
<th>Grade (maximum number of points 100)</th>
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</table>

<table>
<thead>
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<th>points</th>
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<td>projects</td>
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<tr>
<td>The name of the course</td>
<td>Information Technologies for Development of E-Government Systems</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Stoimenov V. Leonid</td>
<td></td>
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</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Veljković Ž. Nataša</td>
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<tr>
<td>Course objectives</td>
<td>Introducing students with basic e-Government concepts and technologies needed for designing and implementation of different aspects of such systems.</td>
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<tr>
<td>Course outcomes</td>
<td>Theoretical and practical knowledge about concepts, design and implementation of basic e-Government aspects.</td>
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<tr>
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<td>OFE</td>
<td>Study and research work</td>
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<tr>
<td>2</td>
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<tr>
<td>Teaching methods</td>
<td>Lectures, laboratory exercises, laboratory sessions, students work on assignments and projects, student seminars.</td>
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<td>Grade (maximum number of points 100)</td>
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<td>colloquia</td>
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<td>projects</td>
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### Specification for the book of courses

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<td>Algorithms and Architectures of Dedicated Computer Systems</td>
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<tr>
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<td>Milentijević Z. Ivan</td>
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<tr>
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</tr>
<tr>
<td>Number of ECTS</td>
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</tbody>
</table>

**Prerequisites**

- **Course objectives**: The main objective is adoption of hardware design techniques and hardware implementation of DSP algorithms.
- **Course outcomes**: Student is expected to design and implement DSP algorithms on streaming processors.

**Course outline**


**Practical teaching (exercises, OFE, study and research work)**


**Textbooks/references**


**Number of classes of active education per week during semester/trimester/year**

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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<td>2</td>
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</table>

**Teaching methods**

Lectures, auditive exercises, lab practicing

**Grade (maximum number of points 100)**

<table>
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<th>Pre-exam duties</th>
<th>Final exam</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
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<td>projects</td>
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<td>Embedded Systems</td>
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<tr>
<td>Course objectives</td>
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<td>Course outcomes</td>
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<tr>
<td>Course outline</td>
<td>Embedded processing, Characteristics of embedded computers. Specifications, requirements, models of computation, language characteristics. Embedded system hardware, input, communication, processing units, memory, output. Embedded operating systems, execution planning, prediction of execution time, Middleware. Implementation of Embedded systems, hardware / software codesign, Concurrent management at tasks level, compiler for embedded systems. Reducing power consumption, dynamic power management. SoC design. SoC architecture, accelerator processor. Complex SoC architecture. Application-specific and configurable processors. Multiprocessor SoC's. Validation, simulation, emulation and prototyping, testing, fault simulation, fault injection, formal verification.</td>
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<tr>
<td>Theoretical teaching</td>
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<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Practical classes are held in the available development systems.</td>
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<tr>
<td>Textbooks/references</td>
<td>1 Stuart R. Ball, Embedded Microprocessor Systems - Real World Design, Elsevier Science, 3th Ed, 2002</td>
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<td></td>
<td>2 Peter Marwedel, Embedded system design, Springer, 2006</td>
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<tr>
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<td>points Final exam points</td>
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<tr>
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<tr>
<td>The name of the course</td>
<td>VoIP Networks</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Ćirić M. Vladimir</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Dimitrijević M. Aleksandar</td>
</tr>
<tr>
<td>Lecturer/associate (for OFE)</td>
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<tr>
<td>Number of ECTS</td>
<td>4</td>
</tr>
<tr>
<td>Course status (obligatory/elective)</td>
<td>elective</td>
</tr>
</tbody>
</table>

#### Prerequisites

- Overview of available standards and protocols on which the Internet telephony is based. Architecture of VoIP networks. Students should be familiar with the components and architecture of a VoIP network.

#### Course objectives

- It is expected for the students to acquire the knowledge required to design, implement, and configure the network for Internet telephony. Students will gain the necessary theoretical and practical knowledge to implement different security models and protocols.

#### Course outline

<table>
<thead>
<tr>
<th>Theoretical teaching</th>
<th>Practical teaching (exercises, OFE, study and research work)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signaling protocols (X.25, SS7, ISDN), Packet networks, Voice encoding, Higher level protocols: RTP, RTCP, Multiplexing over UDP protocol, VoIP network architecture, VoIP signaling and call processing, SIP, MGCP, H.323 protocols, VoIP services, Call routing, Connecting to public services, Media gateways, SIP trunking, Network management, Security of VoIP networks, Quality of service.</td>
<td>VoIP network infrastructure, Devices, Protocols, Configuration of dialer services on the routers with VoIP modules, Dialer plans, Call managers, Installation, configuration and scripting language of Asterisk PBX, Router VoIP module, Asterisk PBX and SIP interconnections, VoIP providers.</td>
</tr>
</tbody>
</table>

#### Textbooks/references

3. 
4. 
5. 

#### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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#### Teaching methods

Lectures, Lab. exercises, Homeworks, and projects, student seminars (presentation and discussion of students’ work).

#### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
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<tbody>
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### Specification for the book of courses

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<tr>
<td>Module</td>
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<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Mobile Computing</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Milentijević Z. Ivan</td>
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<tr>
<td>Lecturer/associate (for exercises)</td>
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<tr>
<td>Course status</td>
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</tbody>
</table>

#### Prerequisites

- The main objective is to familiarize students with mobile computer systems.
- Student is expected to develop mobile computer systems and mobile applications.

#### Course outline

<table>
<thead>
<tr>
<th>Theoretical teaching</th>
<th>Practical teaching (exercises, OFE, study and research work)</th>
</tr>
</thead>
</table>

#### Textbooks/references

2. 
3. 
4. 
5. 

#### Number of classes of active education per week during semester/trimester/year

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#### Teaching methods

- Lectures, auditive exercises, lab practicing

#### Grade (maximum number of points 100)

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<th>points</th>
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<td>Sensors, Transducers and Actuators</td>
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<td>Lecturer (for lectures)</td>
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<td>Lecturer/associate (for exercises)</td>
<td>Milenković V. Vladeta</td>
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</tr>
<tr>
<td><strong>Prerequisites</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Course objectives</strong></td>
<td>Mastering the basic knowledge necessary to use sensors for measuring non-electrical quantities with electrical methods.</td>
</tr>
<tr>
<td><strong>Course outcomes</strong></td>
<td>Theoretical knowledge. Mastering the using of relevant sensors and electronic circuits.</td>
</tr>
<tr>
<td><strong>Teaching methods</strong></td>
<td>Lectures, Auditory exercises, Laboratory exercises, Consultations.</td>
</tr>
<tr>
<td><strong>Number of classes of active education per week during semester/trimester/year</strong></td>
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<tr>
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### Study program
Computing and Informatics

### Module
Computer Engineering

### Type and level of studies
MSc

### The name of the course
3D Graphics Pipelines

### Lecturer (for lectures)
Rančić D. Dejan, Milosavljević Lj. Aleksandar

### Lecturer/associate (for exercises)
Dimitrijević M. Aleksandar

### Lecturer/associate (for OFE)

<table>
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<th>4</th>
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</thead>
</table>

### Course status (obligatory/elective)
elective

### Prerequisites
Introduction to 3D graphics pipelines, their programable stages and programming.

### Course objectives
Theoretical and practical knowledge in programming 3D graphics pipelines, and implementation skills using OpenGL API.

### Course outcomes

<table>
<thead>
<tr>
<th>Theoretical teaching</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Practical teaching (exercises, OFE, study and research work)</th>
</tr>
</thead>
<tbody>
<tr>
<td>All topics are illustrated through exercises using practical implementation in OpenGL.</td>
</tr>
</tbody>
</table>

### Textbooks/references
5. Various GPU vendors' technical reports, whitepapers and programmers guides.

### Number of classes of active education per week during semester/trimester/year

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### Teaching methods
Lectures, exercises, lab. exercises, individual student work.

### Grade (maximum number of points 100)

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</tr>
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<tr>
<td>The name of the course</td>
<td>High-performance Computing</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Stojanović M. Natalija</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Dimitrijević M. Aleksandar</td>
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</tbody>
</table>

| Number of ECTS | 4 | Course status (obligatory/elective) | elective |

<table>
<thead>
<tr>
<th>Prerequisites</th>
</tr>
</thead>
</table>

| Course objectives | Acquiring knowledge to develop high performance applications that require intensive computation and processing large amounts of data on modern computer architectures (GPU, multicore PCs, network of workstations, cluster, grid, etc.) in different domains. |
|-------------------|

| Course outcomes | Understanding the concepts and technologies of high-performance computing as well as acquiring the theoretical and practical knowledge for the development and analysis of high performance applications on modern computer architectures. |
|------------------|

<table>
<thead>
<tr>
<th>Course outline</th>
</tr>
</thead>
</table>

| Theoretical teaching | Overview of advanced concepts, methods and techniques in high-performance computing (HPC High Performance Computing). High-performance computing in distributed environment on the network of workstations (cluster), grid and cloud computing. High-performance computing on multi-core computers with shared memory and many-core architectures, such as graphics processing unit (GPU). High-performance computing on hybrid architectures. Modern technologies to achieve high performance (CUDA / OpenCL, OpenMP, MPI, MapReduce). Performance analysis, assessment and improvement of HPC systems using appropriate tools. HPC applications in geographical information systems (GIS), image processing, environmental protection, business systems, bioinformatics, etc. |
|------------------|

| Practical teaching (exercises, OFE, study and research work) | Work through the HPC examples over the set of laboratory exercises. CUDA application development and performance analysis. OpenMP application development and performance analysis. |
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<table>
<thead>
<tr>
<th>Textbooks/references</th>
</tr>
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<table>
<thead>
<tr>
<th>3 An introduction to parallel programming / Peter S. Pacheco, Morgan Kaufmann, 2011.</th>
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<table>
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<tr>
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| Teaching methods | Lectures, Lab. exercises, Homeworks, and projects, student seminars (presentation and discussion of students’ work). |
|------------------|

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<th>Final exam</th>
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</thead>
<tbody>
<tr>
<td>activity during lectures</td>
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<td>Module</td>
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<td>MSc</td>
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<tr>
<td>The name of the course</td>
<td>Fault Tolerant Systems</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Milovanović I. Emina, Milentijević Z. Ivan</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Milovanović I. Emina</td>
</tr>
<tr>
<td>Number of ECTS</td>
<td>4</td>
</tr>
</tbody>
</table>

### Prerequisites

- The main objective is to present methods and techniques for fault tolerant system design.

### Course outcomes

- Students are expected to develop fault tolerant systems.

### Course outline

#### Theoretical teaching


#### Practical teaching (exercises, OFE, study and research work)

Exercises through students' projects.

### Textbooks/references


### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
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<tr>
<td>2</td>
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</table>

### Teaching methods

Lectures, auditive exercises, lab practicing

### Grade (maximum number of points 100)

<table>
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<th>points</th>
<th>Final exam</th>
<th>points</th>
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<tr>
<td>The name of the course</td>
<td>Heterogeneous Methods for Digital Signal Processing</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Stanković S. Radomir</td>
</tr>
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<td>Lecturer/associate (for exercises)</td>
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<tr>
<td>Course status (obligatory/elective)</td>
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</table>

#### Prerequisites
- The main objective of the course is to provide students with theoretical and practical knowledge to work with heterogeneous signal processing methods and be trained for their implementation in the relevant technology platforms.
- Students will be able to process the different types of signals using heterogeneous methods.

#### Course outline

##### Theoretical teaching
- Presentation of digitally encoded signals by representations (functional expressions, spectral representation, decision diagrams) at the level of bits and words. The implementation of algorithms for working with signals represented by the heterogeneous structures. Heterogeneity is considered in two senses, first logical (binary, multi-valued in the field of complex numbers), and also for calculations heterogeneous structure are used.

##### Practical teaching (exercises, OFE, study and research work)
- Working with MATLAB, Scilab and specialized software packages, seminars.

#### Textbooks/references
2. Selected papers
3. Teaching materials on the site: [http://cs.elfak.ni.ac.rs/nastava/](http://cs.elfak.ni.ac.rs/nastava/)
4. [Computing and Informatics](http://cs.elfak.ni.ac.rs/nastava/)

#### Grade (maximum number of points 100)

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#### Number of classes of active education per week during semester/trimester/year

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#### Teaching methods
- Lectures by use of slides, seminars and projects.
### Specification for the book of courses

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</tr>
</thead>
<tbody>
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<td>Course status (obligatory/elective)</td>
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#### Prerequisites

To provide students with an insight into the area of soft computing and basic research directions. To show students the basic principles and machine learning algorithms, the elements of fuzzy logic, artificial neural networks, evolutionary computation, and apply them to solve real problems.

#### Course objectives

At the end of the course the student will be able to understand the basic problems, possible solutions and research directions in the field. Students will be able to identify possible applications of neural networks, fuzzy logic, genetic algorithms and machine learning. Students will be able to design and develop programs based on soft computing techniques.

#### Course outcomes

- **Theoretical teaching**

- **Practical teaching (exercises, OFE, study and research work)**

#### Textbooks/references


#### Number of classes of active education per week during semester/trimester/year

<table>
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</table>

#### Teaching methods

Lectures, exercises, individual student work on projects.

#### Grade (maximum number of points 100)

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### Study program
Computing and Informatics

### Module
Computer Engineering

### Type and level of studies
MSc

### The name of the course
Computational Neuroscience

### Lecturer (for lectures)
Stanković V. Vladimir

### Lecturer/associate (for exercises)
Stanković V. Vladimir

### Lecturer/associate (for OFE)

### Number of ECTS
4

### Course status (obligatory/elective)
elective

### Prerequisites

### Course objectives
Introduction with the basics of computational neuroscience and the possibilities of applying computing in contemporary neuroscience.

### Course outcomes
The students will get to know the basics of computational neuroscience and obtain the needed knowledge for application and system development which may be applied in the contemporary neuroscience.

### Course outline

#### Theoretical teaching

#### Practical teaching (exercises, OFE, study and research work)
Developing/Superstructure of a computational model or a computer/microcomputer/cell-phone/smartphone etc. application i.e. a proper system/part of a system from the field of computational neuroscience.

### Textbooks/references

<table>
<thead>
<tr>
<th></th>
<th>Authors</th>
<th>Title</th>
<th>Publisher</th>
</tr>
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<tbody>
<tr>
<td>2</td>
<td>H. Riecke</td>
<td>Introduction to Computational Neuroscience</td>
<td>Northwestern University, Wadsworth, 2011.</td>
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<th>Final exam</th>
<th>points</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
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<td>written exam</td>
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<td>exercises</td>
<td></td>
<td>oral exam</td>
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<tr>
<td>colloquia</td>
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<tr>
<td>projects</td>
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</table>

### Teaching methods
Lectures, exercises, consulting, individual or group project labour
### Specification for the book of courses

<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
<td>Software Engineering</td>
</tr>
<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Advanced Software Engineering</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Rančić D. Dejan, Milosavljević Lj. Aleksandar</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Predić B. Bratislav</td>
</tr>
</tbody>
</table>

**Number of ECTS**: 4  
**Course status (obligatory/elective)**: elective

**Prerequisites**

**Course objectives**: Learning advanced methods for the development and evolution of software and methods for measuring the quality of software products and processes.

**Course outcomes**: Theoretical and practical knowledge on advanced methods, techniques and tools for the development and evolution of software products and quality measurement of software products and processes.

**Course outline**


**Textbooks/references**


**Number of classes of active education per week during semester/trimester/year**

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OfE</th>
<th>Study and research work</th>
<th>Other classes</th>
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<tbody>
<tr>
<td>2</td>
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</tbody>
</table>

**Teaching methods**: Lectures, exercises, individual student work on projects.

**Grade (maximum number of points 100)**

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
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<td>Module</td>
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<td>Type and level of studies</td>
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</tr>
<tr>
<td>The name of the course</td>
<td>Intelligent Systems</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Stoimenov V. Leonid, Milosavljević Lj. Aleksandar</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Veljković Ž. Nataša</td>
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<tr>
<td>Number of ECTS</td>
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</tbody>
</table>

| Course status (obligatory/elective) | elective |

#### Prerequisites

Providing students an insight into advanced artificial intelligence techniques. Presenting actual problems and possible solutions for intelligent systems realization, as well as the importance of computing vision, communication and planning for intelligent systems implementation. Introducing students with inference problems related to unreliable knowledge sources. Presenting possible applications of intelligent systems in business systems. Using ontologies for solving problems related to semantical information integration.

#### Course objectives

By the end of the course, a student will be able to understand actual intelligent systems' implementaiton issues, as well as future research and development trends in the field of artificial intelligence. A student will be able to successfully resolve challenges related to choosing and designing parts of intelligent systems. Student will also be capable of recognizing challenges regarding realization of distributed intelligent systems and semantic information integration, and finally implementing some solutions based on ontologies.

#### Course outcomes


#### Theoretical teaching

<table>
<thead>
<tr>
<th>Theoretical teaching</th>
</tr>
</thead>
</table>

#### Practical teaching (exercises, OFE, study and research work)


#### Textbooks/references

3. Д.Бојић, Д.Велашевић, В.Мишић, Збирка задатака из експертских система, Научна книга, Београд, 1996.
4. Power point presentations for the course

#### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
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</table>

<table>
<thead>
<tr>
<th>Teaching methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures, laboratory exercises, laboratory sessions, students work on assignments and projects, student seminars.</td>
</tr>
</tbody>
</table>

#### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
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<tr>
<td>projects</td>
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</table>

<table>
<thead>
<tr>
<th>Lecturer (for lectures)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stoimenov V. Leonid, Milosavljević Lj. Aleksandar</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
</tr>
<tr>
<td>Veljković Ž. Nataša</td>
</tr>
<tr>
<td>Lecturer/associate (for OFE)</td>
</tr>
</tbody>
</table>

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Д.Бојић, Д.Велашевић, В.Мишић, Збирка задатака из експертских система, Научна книга, Београд, 1996.
<table>
<thead>
<tr>
<th>Study program</th>
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<tbody>
<tr>
<td>Module</td>
<td>Software engineering</td>
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<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Geographic Information Systems</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Stojanović H. Dragan</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Predić B. Bratislav, Mihajlović T. Vladan</td>
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<td>Lecturer/associate (for OFE)</td>
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<td>Number of ECTS</td>
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<tr>
<td>Course status (obligatory/elective)</td>
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</tr>
<tr>
<td>Prerequisites</td>
<td></td>
</tr>
<tr>
<td>Course objectives</td>
<td>Acquiring knowledge, methods and technologies required for design and implementation of geographic information systems (GIS).</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>Theoretical and practical knowledge about principles, methods, software tools, components and frameworks for design and implementation of geographic information systems (GIS).</td>
</tr>
<tr>
<td>Course outline</td>
<td></td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Work on design and implementation of geographic information system using commercial and open source software components, frameworks and platforms. Spatial database design. Implementation of GIS functionalities for storage, processing, search and visualization geospatial and spatio-temporal data. Implementation of Web GIS and Web services based on OGC standards and specifications.</td>
</tr>
</tbody>
</table>
4. Scientific papers and articles presented at conferences and published in journals and books.  
5. |
| Number of classes of active education per week during semester/trimester/year | Lectures | Exercises | OFE | Study and research work | Other classes |
| Lectures | 2 | | | | |
| Exercises | 1 | | | | |
| OFE | | | | | |
| Study and research work | | | | | |
| Other classes | | | | | |
| Teaching methods | Lectures, auditive exercises, lab practicing, independent student work on assignments and projects, student seminars. |
| Grade (maximum number of points 100) | Pre-exam duties | Final exam | points | Oral exam |
| activity during lectures | 10 | written exam | | 40 |
| exercises | | oral exam | | |
| colloquia | 40 | | | |
| projects | 10 | | | |
## Specification for the book of courses

<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
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<tbody>
<tr>
<td>Module</td>
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<td>Type and level of studies</td>
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<tr>
<td>The name of the course</td>
<td>Interoperability and Information Integration</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Stoimenov V. Leonid, Tošić B. Milorad</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Stanimirović S. Aleksandar, Bogdanović D. Miloš</td>
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<td>Course status (obligatory/elective)</td>
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</tr>
</tbody>
</table>

### Prerequisites

- Introducing the need for information integration, as well as the need for implementing interoperability of applications and systems. Presenting the issues of information integration and technologies for implementation of integration and systems interoperability.

### Course objectives

- Theoretical and practical knowledge on concepts, ways of solving, designing and implementing basic elements of system interoperability and information integration.

### Course outcomes

- Practical implementation of simple information integration examples that show the existence of heterogeneity issues and solving techniques: technical, semantic and syntax. Information integration architectures: data warehouses, federative databases, mediator based systems. Ontologies and semantic heterogeneity. Solving semantic heterogeneity based issues; ontology types for information integration; mapping between ontologies. Applications and systems interoperability and its significance in enterprises. Approaches and platforms for interoperability implementation. Platforms and frameworks examples: Buster, GeoNis etc. Technologies for interoperability: Enterprise Service Bus, service oriented technologies. Standards and their importance for interoperability. The role of Web portal in interoperable systems. Trust in safety and security in interoperable systems.

### Course outline


### Practical teaching (exercises, OFE, study and research work)

- Practical implementation of simple information integration examples that show the existence of heterogeneity issues and solving techniques: technical, semantic and syntax. Information integration architectures: data warehouses, federative databases, mediator based systems. The role of translators in the architecture and their implementation. Ontologies, RDF and OWL. Implementation of mapping between ontologies. Implementation of system interoperability based on ESB and service oriented architecture. Implementation of Web portal as central access point to integrated information.

### Textbooks/references

| 3 | Internet literature and actual papers |
| 4 |  |
| 5 |  |

### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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### Grade (maximum number of points 100)

<table>
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<tr>
<th>Pre-exam duties</th>
<th>Final exam</th>
<th>Other classes</th>
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<tbody>
<tr>
<td>activity during lectures</td>
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<tr>
<td>projects</td>
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### Specification for the book of courses

**Study program**: Computing and Informatics  
**Module**: Software engineering  
**Type and level of studies**: MSc  
**The name of the course**: Advanced Operating Systems  
**Lecturer (for lectures)**: Stojanović H. Dragan  
**Lecturer/associate (for exercises)**: Stanimirović S. Aleksandar, Predić B. Bratislav  
**Lecturer/associate (for OFE)**:  
**Number of ECTS**: 4  
**Course status (obligatory/elective)**: elective

#### Prerequisites

<table>
<thead>
<tr>
<th>Course objectives</th>
<th>Theoretical knowledge and skills about advanced concepts, internal design and implementation of contemporary operating systems and system software.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course outcomes</td>
<td>Theoretical and practical knowledge about advanced concepts, internal design and implementation of contemporary operating systems and system software.</td>
</tr>
</tbody>
</table>

#### Course outline

**Theoretical teaching**: Advanced concepts, algorithms, technologies and implementation of contemporary operating systems components, such as process/thread management, process synchronization and communication, memory management, UI/CI device drivers, file system and network services. Multimedia operating systems. Security and protection in operating systems. Operating systems of multi processor computers. Distributed operating systems. Operating system of mobile and embedded computers. Special purpose operating systems. Design and implementation of contemporary operating systems and system software. System programming of contemporary operating systems.

**Practical teaching (exercises, OFE, study and research work)**: Work on design and implementation of operating system components and appropriate system software over the set of lab exercise and practical project.

#### Textbooks/references

4. Scientific papers and articles presented at conferences and published in journals and books.

#### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
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<th>OFE</th>
<th>Study and research work</th>
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<tbody>
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</tr>
</thead>
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<tr>
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<td>written exam</td>
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<td>Module</td>
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<td>Requirements Engineering</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Rančić D. Dejan, Milosavljević Lj. Aleksandar</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
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</tr>
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<td><strong>Course status (obligatory/elective)</strong></td>
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</tr>
</tbody>
</table>

#### Prerequisites

**Course objectives**
Introducing students to the field of requirements engineering and in terms of principles of requirements management as well as the basic requirements engineering models.

**Course outcomes**
Knowledge of basic principles and requirements engineering models.

### Course outline

#### Theoretical teaching

- Introduction and history of the field of requirements engineering.
- Requirements management.
- Functional and non-functional requirements.
- Problems in requirements specification.
- The use of standards in the requirements specification.
- Spiral model of requirements management process.
- Requirements elicitation.
- Requirements analysis.
- Requirements validation.
- Types of requirements.
- Requirements characteristics.
- False requirements.
- Methods for requirements engineering.
- DFD diagrams.
- Relational methods.
- Object-oriented methods.
- Formal methods.
- Methods based on the behavior of the system.
- Use-case specification.
- Viewpoint-based methods.
- Software tools for requirements engineering.

#### Practical teaching (exercises, OFE, study and research work)

- Introduction to the software tools for requirements engineering.

### Textbooks/References

4. Other textbooks and references.

### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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<tr>
<td>2</td>
<td>1</td>
<td></td>
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</tbody>
</table>

#### Teaching methods

Lectures, exercises, individual student work on projects.

### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>Points</th>
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<tr>
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<tr>
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**Rančić D. Dejan, Milosavljević Lj. Aleksandar**

Lecturer (for lectures)

**Veljković Ž. Nataša**

Lecturer/associate (for OFE)
<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
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<tbody>
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<td>The name of the course</td>
<td>Computer Animation</td>
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<td>Lecturer (for lectures)</td>
<td>Rančić D. Dejan, Milosavljević Lj. Aleksandar</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Dimitrijević M. Aleksandar</td>
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<tr>
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<tr>
<td>Course objectives</td>
<td>Introduction to the basic algorithms and techniques for computer animation.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>Theoretical and practical knowledge of algorithms and techniques for computer animation. Capability to program graphical applications as well as to use of existing software for computer animation.</td>
</tr>
<tr>
<td>Course outline</td>
<td></td>
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<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Introduction to the software tools for computer animation.</td>
</tr>
<tr>
<td>Textbooks/references</td>
<td></td>
</tr>
<tr>
<td>1 Dejan Rančić, Aleksandar Milosavljević, Slides from lectures (CD), Faculty of Electronic Engineering, Niš, 2013.</td>
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<tr>
<td>Lectures</td>
<td>Exercises</td>
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</tr>
<tr>
<td>Teaching methods</td>
<td>Lectures, exercises, individual student work on projects.</td>
</tr>
<tr>
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<tr>
<td>projects</td>
<td></td>
</tr>
</tbody>
</table>
Course status (obligatory/elective) | elective
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**Prerequisites**

|   | Obtaining knowledge about basic concepts and principles of database management systems (DBMS) and their components. Obtaining knowledge on advanced DBMS usage techniques (triggers, security, query optimization). Obtaining knowledge on basic concepts and principles of advanced database systems functioning. |

**Course objectives**

|   | Theoretical knowledge on DBMSs, their components and usage patterns; practical knowledge on advanced DBMS usage techniques, administration, performance tuning and data maintenance. |

**Course outcomes**

|   | Introduction to database management systems (DBMS). The role and responsibilities of database administrator. Database management system: architecture, basic modules and functions, examples of such systems. Stored procedures. Triggers: term, purpose and trigger usage, syntax of command for creating trigger, trigger types and granularity, row level and expression level triggers, timetable of trigger executions. Query processing and optimization: the term of query optimization, statical and dynamical optimization, system catalogue, database statistics and optimization, index structures and multidimensional indices. DBMS security: the term of DBMS security, user privileges - assigning and deprivation (GRANT and REVOKE commands), privileges propagation, security at view level, statistical databases, DAC and MAC security mechanisms. DBMS trends: OO databases, OQL and SQL, object-relational DBMS, NoSQL databases. DBMS modern trends; storing large amount of distributed data. |

**Theoretical teaching**

|   | The role of database administrator, practical usage of DBMS and administration tools - practical examples and tasks. Database performance tuning, indices creation. Query optimization - practical examples, problems, DBMS tools utilization, DBMS security and role of database administrator, security on operating system level, network level, hardware level etc. - practical examples and tasks. Modern DBMS challenges - example of new technologies utilization (object-relational mappers: Hibernate/NHibernate, XML, etc.). NoSQL databases (the term, basic concept, categorization, examples) and differences regarding traditional DBMS. |

**Practical teaching (exercises, OFE, study and research work)**

|   | Lectures, laboratory exercises, laboratory sessions, students work on assignments and projects, student seminars. |

**Number of ECTS** | 4

**Textbooks/references**

3. Power Point presentations for the course

**Number of classes of active education per week during semester/trimester/year**

<table>
<thead>
<tr>
<th>Lectures</th>
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<th>OFE</th>
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<th>Other classes</th>
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</table>

**Teaching methods**

Lectures, laboratory exercises, laboratory sessions, students work on assignments and projects, student seminars.

**Grade (maximum number of points 100)**

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
<td>written exam</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>exercises</td>
<td>30</td>
<td>oral exam</td>
<td></td>
</tr>
<tr>
<td>colloquia</td>
<td>30</td>
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### Specification for the book of courses

<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
<td>Software Engineering</td>
</tr>
<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Intelligent Transportation Systems</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stojanović H. Dragan, Rančić D. Dejan</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Predić B. Bratislav</td>
</tr>
<tr>
<td>Lecturer/associate (for OFE)</td>
<td></td>
</tr>
<tr>
<td>Number of ECTS</td>
<td>4</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>Introducing the concept of intelligent transportation systems, and the basic elements of these systems, their classification, and functional characteristics of the components.</td>
</tr>
<tr>
<td>Course objectives</td>
<td>Theoretical and practical knowledge of the technological aspects of intelligent transportation systems and architectures of some categories of these systems. Knowledge of ICT technologies involved in the design and implementation of intelligent transportation systems, as well as knowledge of the functional and non-functional characteristics of individual categories of ITS.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td></td>
</tr>
<tr>
<td>Course outline</td>
<td>The definition and classification of intelligent transportation systems. The functionality of the core components of ITS. Geographic Information Systems in ITS (road network analysis, analysis of dynamic and static traffic characteristics, GIS in transport planning and control systems). Vehicle location systems (Automatic Vehicle Location - AVL) and advanced passenger and traffic information systems. Support systems, logistics and management of commercial fleet vehicles. The collection, processing and analysis of data on the dynamic characteristics of the traffic and road infrastructure. Software tools and platforms, and hardware devices used in the implementation of ITS (GPS, sensors in the road infrastructure, vehicle and mobile devices, network models in spatial databases ...). Analysis of the design and implementation of intelligent transportation systems.</td>
</tr>
<tr>
<td>Theoretical teaching</td>
<td>Design and implementation of intelligent transportation system components and applications through a set of laboratory exercises and projects that follow the topics covered in lectures.</td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td></td>
</tr>
<tr>
<td>Textbooks/references</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pablo Luque, Johan Wideberg, Daniel Mantaras, An intelligent transportation system to improve safety and efficiency OBD-II and smartphone apps., CreateSpace Independent Publishing Platform, 2012.)</td>
</tr>
<tr>
<td>4</td>
<td>Asvin Goel, Fleet Telematics - Real-time management and planning of commercial vehicle operations, Springer, 2007</td>
</tr>
<tr>
<td>5</td>
<td>Scientific papers and articles presented at conferences and published in journals and books</td>
</tr>
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</tr>
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<tr>
<td>Teaching methods</td>
<td>Lectures, laboratory exercises, laboratory sessions, students work on assignments and projects, student seminars.</td>
</tr>
<tr>
<td>Grade (maximum number of points 100)</td>
<td>Pre-exam duties</td>
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<tr>
<td>activity during lectures</td>
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<td>exercises</td>
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<td>colloquia</td>
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<td>projects</td>
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<td>Module</td>
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<td>Type and level of studies</td>
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<tr>
<td>The name of the course</td>
<td>Ubiquitous Computing</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stojanović H. Dragan</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Predić B. Bratislav, Davidović P. Nikola</td>
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</tr>
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<td>Number of ECTS</td>
<td>4</td>
</tr>
<tr>
<td>Course status</td>
<td>elective</td>
</tr>
<tr>
<td>Prerequisites</td>
<td></td>
</tr>
<tr>
<td>Course objectives</td>
<td>Acquiring theoretical and practical knowledge in ubiquitous computing domain, particularly fundamental concepts, method and technologies for design and implementation of mobile and ubiquitous systems, applications and services.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>Theoretical and practical knowledge about principles, methods, technologies and software tools for development of mobile and ubiquitous applications and services in ubiquitous computing.</td>
</tr>
<tr>
<td>Course outline</td>
<td></td>
</tr>
<tr>
<td>Theoretical teaching</td>
<td>Ubiquitous computing vision. Mobile and ubiquitous computer, communication and sensor devices. Advanced wireless and ad-hoc networks. Positioning technologies and location-based ubiquitous applications. Sensing and acquisition of context in ubiquitous computing and development of ubiquitous context-aware systems, applications and services. Smart labels (barcodes) and RFID. Data management in mobile and ubiquitous computing. Wireless sensor network platforms and systems. Human interaction with ubiquitous computer systems. Activity recognition. Wearable computing. Privacy and security in ubiquitous computing. Advance applications and services: smart home, ubiquitous health care, intelligent transportation systems, monitoring and control, environmental protection, etc.</td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Work on design and implementation of ubiquitous system components and application over the set of lab exercise and practical project that follows topics covered at theoretical classes.</td>
</tr>
<tr>
<td></td>
<td>4 Scientific papers and articles presented at conferences and published in journals and books.</td>
</tr>
<tr>
<td></td>
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<td>OFE</td>
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<td>Study and research work</td>
<td></td>
</tr>
<tr>
<td>Other classes</td>
<td></td>
</tr>
<tr>
<td>Teaching methods</td>
<td>Lectures, auditive exercises, lab practicing, independent student work on assignments and projects, student seminars.</td>
</tr>
<tr>
<td>Grade (maximum number of points 100)</td>
<td>Pre-exam duties</td>
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<td>MSc</td>
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<td>The name of the course</td>
<td>Software Testing and Quality</td>
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<tr>
<td>Lecturer (for lectures)</td>
<td>Janković S. Dragan, Stojković R. Suzana</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Bogdanović D. Miloš</td>
</tr>
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<td>Lecturer/associate (for OFE)</td>
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<td>Elective</td>
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<tr>
<td>Prerequisites</td>
<td></td>
</tr>
<tr>
<td>Course objectives</td>
<td>Introduction to the concept of software quality and testing, basic techniques for software testing.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>Theoretical and practical knowledge about software quality and testing techniques. Built critical approach to software quality and awareness of the importance of software testing.</td>
</tr>
<tr>
<td>Course outline</td>
<td></td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Auditory and laboratory exercises. Test generation for different kind of testing. Software testing using different testing tools as Junit, Nunit, etc. Introduction to the use of tool Bugzilla. Introduction to the version control systems.</td>
</tr>
<tr>
<td></td>
<td>2 Mauro Pezze, Michal Young, Software testing and Analysis: process, principles and techniques, John Wiley &amp; Sons, 2007.</td>
</tr>
<tr>
<td></td>
<td>4 Lectures in a form of Power Point presentations</td>
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<td>Lectures</td>
<td>Exercises</td>
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</tr>
<tr>
<td>Teaching methods</td>
<td>Lectures, Auditive exercises, Laboratory exercises. Student project realization.</td>
</tr>
<tr>
<td>Grade (maximum number of points 100)</td>
<td>Pre-exam duties</td>
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<td>exercises</td>
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<td>projects</td>
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### Course status (obligatory/elective)

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### Prerequisites

<table>
<thead>
<tr>
<th>Course objectives</th>
<th>Course outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to the field of virtual and augmented reality in terms of basic devices, algorithms, and techniques that are used to implement these systems.</td>
<td>Students will gain knowledge on basic principles, devices, techniques, and algorithms used in implementing virtual and augmented reality systems.</td>
</tr>
</tbody>
</table>

### Course outline

<table>
<thead>
<tr>
<th>Theoretical teaching</th>
<th>Practical teaching (exercises, OFE, study and research work)</th>
</tr>
</thead>
</table>

### Textbooks/references


### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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<tbody>
<tr>
<td>2</td>
<td>1</td>
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<td></td>
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</tbody>
</table>

### Teaching methods

Lectures, exercises, individual student work on projects.

### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>Points</th>
<th>Final exam</th>
<th>Oral exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
<td>10</td>
<td>written exam</td>
<td>30</td>
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<tr>
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<td>oral exam</td>
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</thead>
<tbody>
<tr>
<td>Module</td>
<td>Information Technology</td>
</tr>
<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Data Mining Techniques and Methods</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stanković M. Milena, Stojković R. Suzana</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Jovanović D. Martin</td>
</tr>
<tr>
<td>Lecturer/associate (for OFE)</td>
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</tr>
<tr>
<td>Number of ECTS</td>
<td>4</td>
</tr>
<tr>
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<td>elective</td>
</tr>
<tr>
<td>Prerequisites</td>
<td></td>
</tr>
<tr>
<td>Course objectives</td>
<td>The goal of this course is to introduce students to major data mining tasks and with special emphasis on the using the data mining techniques and methods into text analysis and information retrieval systems.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>After completing this course, students should acquire theoretical knowledge of the principles of the work of the data mining tools and to be able to use existing datamining open source tools and to develop new.</td>
</tr>
<tr>
<td>Course outline</td>
<td></td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Working with existing data mining open source tools (especially with classification and clustering tools). Integration the data mining tools into information retrieval systems.</td>
</tr>
<tr>
<td></td>
<td>4. ppt prezentations from lectures</td>
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<tr>
<td>Number of classes of active education per week during semester/trimester/year</td>
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<td>OFE</td>
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<tr>
<td>Study and research work</td>
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<tr>
<td>Other classes</td>
<td></td>
</tr>
<tr>
<td>Grade (maximum number of points 100)</td>
<td>activity during lectures</td>
</tr>
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<td>exercises</td>
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<td>colloquia</td>
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<td>projects</td>
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# Specification for the book of courses

<table>
<thead>
<tr>
<th>Course status (obligatory/elective)</th>
<th>elective</th>
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</thead>
<tbody>
<tr>
<td><strong>Prerequisites</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Course objectives</strong></td>
<td></td>
</tr>
<tr>
<td>Mastering the basic skills required for basic use of procedures in computer modeling and simulation.</td>
<td></td>
</tr>
<tr>
<td><strong>Course outcomes</strong></td>
<td></td>
</tr>
<tr>
<td>Theoretical Knowledge: Mastering the techniques of mathematical modeling and computer simulation, 3D modeling and simulation of computer programming.</td>
<td></td>
</tr>
</tbody>
</table>

## Course outline

### Theoretical teaching


### Practical teaching (exercises, OFE, study and research work)


## Textbooks/references


## Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Teaching methods

- Lectures, supervised, laboratory sessions, students work independently on assignments and projects, consultancy.

## Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>Final exam</th>
<th>points</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
<td>written exam</td>
<td></td>
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<tr>
<td>exercises</td>
<td>oral exam</td>
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<tr>
<td>colloquia</td>
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<td>projects</td>
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## Specification for the book of courses

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<th>Computing and Informatics</th>
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</thead>
<tbody>
<tr>
<td>Module</td>
<td>Information Technologies</td>
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<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Application of Multiple Valued Logic in Representation and Processing of Digital Signals</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stanković S. Radomir</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Radmanović M. Miloš</td>
</tr>
<tr>
<td>Number of ECTS</td>
<td>4 Course status (obligatory/elective) elective</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>Students will acquire theoretical and practical knowledge in filed of multiple-valued logic and its application in digital system design and signal processing.</td>
</tr>
<tr>
<td>Course objectives</td>
<td>Students will learn fundamentals of multiple-valued logic, related algebraic structures, and multiple-valued functions, their representation and implementation on the different technological platforms. They will learn fundamental methods for calculation of multiple-valued functions for use in digital system design and signal processing.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td></td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Work with the specific software and tools for multiple-valued logic. Program implementation of the fundamental algorithms for multiple-valued functions on the graphical processors.</td>
</tr>
<tr>
<td></td>
<td>3 Teaching materials on the site: <a href="http://cs.elfak.ni.ac.rs/nastava/">http://cs.elfak.ni.ac.rs/nastava/</a></td>
</tr>
<tr>
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<td>5 Teaching materials on the site: <a href="http://cs.elfak.ni.ac.rs/nastava/">http://cs.elfak.ni.ac.rs/nastava/</a></td>
</tr>
<tr>
<td>Number of classes of active education per week during semester/trimester/year</td>
<td>Lectures Exercises OFE Study and research work Other classes</td>
</tr>
<tr>
<td></td>
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<tr>
<td>Teaching methods</td>
<td>Presentations bz use of slides, seminars and projects.</td>
</tr>
<tr>
<td>Grade (maximum number of points 100)</td>
<td>Pre-exam duties points Final exam points</td>
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<tr>
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<td>activity during lectures written exam</td>
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<tr>
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<td>exercises oral exam</td>
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<td>colloquia</td>
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<td>projects 60</td>
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<tbody>
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<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Fundamental Technics of Web Mining</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stanković M. Milena</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Jovanović D. Martin</td>
</tr>
</tbody>
</table>

| Number of ECTS | 4 | Course status (obligatory/elective) | elective |

| Prerequisites |

| Course objectives |
Through this course, students will become familiar with specific analysis of Web documents and unstructured data analysis. Also, they will learn about application of those technologies |

| Course outcomes |
Students will have opportunity to acquire theoretical and practical knowledge in the field to Web documents content analysis, and document classification and clustering. They will become familiar with the techniques and tools for Web structure analysis and Web usage analysis. |

| Course outline |

| Theoretical teaching |

| Practical teaching (exercises, OFE, study and research work) |

| Textbooks/references |
2 Teaching materials on the site: http://cs.elfak.ni.ac.rs/nastava/ |
3 |
4 |
5 |

| Number of classes of active education per week during semester/trimester/year |

<table>
<thead>
<tr>
<th>Lectures</th>
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<th>OFE</th>
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<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Teaching methods |
Lectures by use of slides and interactive work on the computer. Seminars and projects. |

| Grade (maximum number of points 100) |

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
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<tr>
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</tr>
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<td>colloquia</td>
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<td>projects</td>
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<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Patterns Recognition</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stanković S. Radomir</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Radmanović M. Miloš</td>
</tr>
<tr>
<td>Lecturer/associate (for OFE)</td>
<td></td>
</tr>
<tr>
<td>Number of ECTS</td>
<td>4</td>
</tr>
<tr>
<td>Course status (obligatory/elective)</td>
<td>elective</td>
</tr>
<tr>
<td>Prerequisites</td>
<td>The goal of this course is to introduce students to the basic methods and techniques for pattern-recognition and gain sufficient knowledge for independent research work in this field and for practical realization of pattern-recognition applications.</td>
</tr>
<tr>
<td>Course objectives</td>
<td>In this course students will learn main methods and techniques in the field of pattern recognition to enable them effectively problem solving, and independent research work in the field of pattern recognition.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td></td>
</tr>
<tr>
<td>Theoretical teaching</td>
<td>Preparation of seminar papers in the field of pattern recognition and oral presentation.</td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td></td>
</tr>
</tbody>
</table>
4 Teaching materials on the site: http://cs.elfak.ni.ac.rs/nastava/ |
| Number of classes of active education per week during semester/trimester/year | |
| Lectures | Exercises | OFE | Study and research work | Other classes |
| 2 | 1 | |
| Teaching methods | Lectures by use of slides and interactive work on the computer. Seminars and projects. |
| Grade (maximum number of points 100) | |
| Pre-exam duties | points | Final exam | points |
| activity during lectures | | written exam | |
| exercises | | oral exam | 40 |
| colloquia | | | |
| projects | | | 60 |
**Study program** | Computing and Informatics  
---|---  
**Module** | Information Technologies  
**Type and level of studies** | MSc  
**The name of the course** | Advanced Techniques for Image Processing  
**Lecturer (for lectures)** | Stanković S. Radomir  
**Lecturer/associate (for exercises)** | Radmanović M. Miloš  
**Lecturer/associate (for OFE)** |  
**Number of ECTS** | 4  
**Course status (obligatory/elective)** | elective  
**Prerequisites** |  
**Course objectives** | The main goal of this course is to introduce students into fundamental techniques for digital image processing and possibilities for applications of those techniques in practical problems solving. An additional aim is to prepare students for independent research work in field of image processing and design of applications.  
**Course outcomes** | Students will learn fundamental techniques for image discretization by sampling, image compression, noise diagnostic, filtering, digital image transforms, linear and nonlinear filtering.  
**Course outline** |  
**Practical teaching (exercises, OFE, study and research work)** | Implementation of main algorithms in MATLAB. Preparation and presentation of seminars and projects.  
**Textbooks/references** |  
4. Teaching materials on the site: http://cs.elfak.ni.ac.rs/nastava/  
5.  
**Number of classes of active education per week during semester/trimester/year** |  
<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Teaching methods** | Self studying by use of teaching materials on the Internet.  
**Grade (maximum number of points 100)** |  
<p>| Pre-exam duties | points | Final exam | points |<br />
| activity during lectures | | written exam | |<br />
| exercises | | oral exam | 30 |<br />
| colloquia | 30 | | |<br />
| projects | 40 | | |</p>
<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
<td>Information Technologies</td>
</tr>
<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Advanced Web Technologies</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Petković M. Ivan</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Petković M. Ivan</td>
</tr>
<tr>
<td>Number of ECTS</td>
<td>4</td>
</tr>
<tr>
<td>Course status (obligatory/elective)</td>
<td>elective</td>
</tr>
<tr>
<td>Prerequisites</td>
<td></td>
</tr>
<tr>
<td>Course objectives</td>
<td>The goal of the course is to familiarize students with modern Web technologies that contribute to the efficient use of the Internet as a global resource, which means working with different types of data, structured and unstructured, and the development of Web applications that are accessible to a large number of users using different client applications.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>Students should know how to use XML and Web services to integrate applications and data. Also they know technologies for development of Web 2.0 applications as well as applications with elements of Semantic Web and they will be be able to implement projects that integrates advanced Web technology.</td>
</tr>
<tr>
<td>Course outline</td>
<td></td>
</tr>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>AJAX, HTML 5, CSS3. Java Internet technologies, JSP (Java Server Pages), JSP templates and database access. Using Web services technology.</td>
</tr>
<tr>
<td></td>
<td>2. Java programming resources: <a href="http://www.apl.jhu.edu/~hall/java/">http://www.apl.jhu.edu/~hall/java/</a></td>
</tr>
<tr>
<td></td>
<td>3. Teaching materials on the site: <a href="http://cs.elfak.ni.ac.rs/nastava/">http://cs.elfak.ni.ac.rs/nastava/</a></td>
</tr>
<tr>
<td></td>
<td>4.</td>
</tr>
<tr>
<td></td>
<td>5.</td>
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<tr>
<td>Number of classes of active education per week during semester/trimester/year</td>
<td></td>
</tr>
<tr>
<td>Lectures</td>
<td>Exercises</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Teaching methods</td>
<td>Lectures by use of slides, seminars, projects.</td>
</tr>
<tr>
<td>Grade (maximum number of points 100)</td>
<td></td>
</tr>
<tr>
<td>Pre-exam duties</td>
<td>points</td>
</tr>
<tr>
<td>activity during lectures</td>
<td>written exam</td>
</tr>
<tr>
<td>exercises</td>
<td>oral exam</td>
</tr>
<tr>
<td>colloquia</td>
<td></td>
</tr>
<tr>
<td>projects</td>
<td>60</td>
</tr>
</tbody>
</table>
The students should get the knowledge of the current state and future trends in medical informatics. They should develop the skills to critically examine benefits and disadvantages of applying different software solutions in medicine.


The topics presented on the auditive and laboratory exercises follow material presented during lectures. The exercises are envisioned as a basis for the individual student projects development.
After completing this course the student acquires theoretical and practical knowledge necessary for development of applications based on natural language processing.

The goal of this course is to introduce students to the basic concepts and ideas of the Natural Language Processing (NLP) and with applications of these concepts in information extraction, information retrieval systems, sentiment analysis, question answering, automatic translation ...

Introduction to existing open-source tools for processing the data written in a natural language and for data conversion from unstructural form (text) to structural convenient for further processing. Integration of the NLP tools into information retrieval systems.


Introduction to existing open-source tools for processing the data written in a natural language and for data conversion from unstructural form (text) to structural convenient for further processing. Integration of the NLP tools into information retrieval systems.

Textbooks/references


3. ppt presentations from lectures

4.  

5.  

Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Teaching methods

Lectures, auditorial exercises, lab. practice, student seminars (presentation and discussion of students' work)

Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
<td>10</td>
<td>written exam</td>
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<tr>
<td>exercises</td>
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<td>oral exam</td>
<td>30</td>
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<tr>
<td>colloquia</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>projects</td>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Course outline

#### Theoretical teaching
- Walsh, Haar, arithmetic transform, Reed-Muller transform for binary-valued functions and Vilenkin-Chrestenson transform, generalized Haar, and other related transforms for multiple-valued functions.
- Polynomial expressions and decision diagram representations for switching and multiple-value functions.
- Spectral analysis of Boolean functions.
- Spectral synthesis and optimization of combinational and sequential devices.
- Spectral methods in analysis and synthesis of reliable devices.
- Spectral techniques for testing computer hardware.

#### Practical teaching (exercises, OFE, study and research work)
- Work with specialized software packages and tools.
- Program implementation of the algorithms for calculation of digital transforms and its application.

### Textbooks/references

2. Teaching materials on the site: [http://cs.elfak.ni.ac.rs/nastava/](http://cs.elfak.ni.ac.rs/nastava/)
3. Материјал на сајту: [http://cs.elfak.ni.ac.rs/nastava/](http://cs.elfak.ni.ac.rs/nastava/)
4. Материјал на сајту: [http://cs.elfak.ni.ac.rs/nastava/](http://cs.elfak.ni.ac.rs/nastava/)

### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
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<th>Study and research work</th>
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<td></td>
<td></td>
<td></td>
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</tbody>
</table>

### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
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<th>Final exam</th>
<th>points</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
<td>written exam</td>
<td>oral exam</td>
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<td>exercises</td>
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<td></td>
<td></td>
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<tr>
<td>colloquia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>projects</td>
<td>60</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Specification for the book of courses

<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
<td>Information Technologies</td>
</tr>
<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Fuzzy Logic</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stanković S. Radomir</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Radmanović M. Miloš</td>
</tr>
<tr>
<td>Number of ECTS</td>
<td>4 Course status (obligatory/elective) elective</td>
</tr>
</tbody>
</table>

#### Prerequisites

<table>
<thead>
<tr>
<th>Course objectives</th>
<th>Students should acquire fundamentals of Fuzzy Logic and its applications in computing, automatic control and related areas.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course outcomes</td>
<td>At the end of this course students should know what are Fuzzy systems, what are their characteristics, descriptions methods and implementation techniques,. Students should learn how to implement simple Fuzzy systems.</td>
</tr>
</tbody>
</table>

#### Course outline

<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Practical teaching (exercises, OFE, study and research work)</td>
<td>Seminars and project related to the application of Fuzzy logic.</td>
</tr>
</tbody>
</table>

#### Textbooks/references

3. 
4. 
5. 

#### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Teaching methods

Self studing by use of video lectures on the Internet.

#### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
<td>written exam</td>
<td></td>
<td></td>
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<tr>
<td>exercises</td>
<td>oral exam</td>
<td>40</td>
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<tr>
<td>colloquia</td>
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</tr>
<tr>
<td>projects</td>
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</tr>
</tbody>
</table>
### Study program
Computing and Informatics

### Module
Information Technology

### Type and level of studies
MSc

### The name of the course
Advanced Techniques in 3D Modeling and Animation

### Lecturer (for lectures)
Vučković V. Vladan

### Lecturer/associate (for exercises)
Vučković V. Vladan

### Lecturer/associate (for OFE)

### Number of ECTS
4

### Course status (obligatory/elective)
elective

### Prerequisites

### Course objectives
Mastering the basic skills necessary to use advanced processes and procedures in a computer 3D modeling and animation.

### Course outcomes
Theoretical Knowledge: Mastering advanced techniques for computer 3D modeling and animation, 3D modeling, programming, and generate a camera path animation on the computer.

### Course outline

<table>
<thead>
<tr>
<th>Theoretical teaching</th>
<th>Practical teaching (exercises, OFE, study and research work)</th>
</tr>
</thead>
</table>

### Textbooks/references

### Number of classes of active education per week during semester/trimester/year

<table>
<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>2</td>
</tr>
</tbody>
</table>

### Teaching methods
Lectures, supervised, laboratory sessions, students work independently on assignments and projects, consultancy.

### Grade (maximum number of points 100)

<table>
<thead>
<tr>
<th>Pre-exam duties</th>
<th>points</th>
<th>Final exam</th>
<th>points</th>
</tr>
</thead>
<tbody>
<tr>
<td>activity during lectures</td>
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<td></td>
<td></td>
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<td>oral exam</td>
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<tr>
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### Specification for the book of courses

<table>
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<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Social Networks Analysis</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Tošić B. Milorad</td>
</tr>
<tr>
<td>Lecturer/associate (for OFE)</td>
<td>Nejković M. Valentina</td>
</tr>
<tr>
<td>Number of ECTS</td>
<td>4</td>
</tr>
<tr>
<td>Course status (obligatory/elective)</td>
<td>elective</td>
</tr>
<tr>
<td>Prerequisites</td>
<td></td>
</tr>
<tr>
<td>Course objectives</td>
<td>Gaining practical programming skills, theoretical knowledge and systematic approach required for the design, implementation and operation of systems in which information technologies, computers, the Internet, and humans act in concert to form complex structures that are commonly characterized as social networks.</td>
</tr>
<tr>
<td>Course outcomes</td>
<td>Students are able to identify areas of usage, specific problems and relevant theoretical concepts needed to solve them, possess practical programming skills needed to implement specific examples of usage.</td>
</tr>
<tr>
<td>Textbooks/references</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Web site with materials for lectures and exercises. Materials available on the Internet</td>
</tr>
<tr>
<td>Number of classes of active education per week during semester/trimester/year</td>
<td></td>
</tr>
<tr>
<td>Lectures</td>
<td>Exercises</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Teaching methods</td>
<td>Lectures, Auditorial exercises, Laboratory exercises; Consultations, Independent students' research; students' oral presentation to the selected / given topics; Active students' participation in the classroom using an interactive course Web site</td>
</tr>
<tr>
<td>Grade (maximum number of points 100)</td>
<td></td>
</tr>
<tr>
<td>Pre-exam duties</td>
<td>points</td>
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<td>projects</td>
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<tr>
<td><strong>Study program</strong></td>
<td>Computing and Informatics</td>
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<tr>
<td>-------------------</td>
<td>--------------------------</td>
</tr>
<tr>
<td><strong>Module</strong></td>
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<tr>
<td><strong>Type and level of studies</strong></td>
<td>MSc</td>
</tr>
<tr>
<td><strong>The name of the course</strong></td>
<td>Project Management and Organization</td>
</tr>
<tr>
<td><strong>Lecturer (for lectures)</strong></td>
<td>Milentijević Z. Ivan</td>
</tr>
<tr>
<td><strong>Lecturer/associate (for exercises)</strong></td>
<td>Vojinović M. Oliver</td>
</tr>
<tr>
<td><strong>Lecturer/associate (for OFE)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Number of ECTS</strong></td>
<td>4</td>
</tr>
<tr>
<td><strong>Prerequisites</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Course objectives</strong></td>
<td>To familiarize students with basic principles of the organization of the project. To provide practical experience in planning, monitoring and managing the project.</td>
</tr>
<tr>
<td><strong>Course outcomes</strong></td>
<td>At the end of the course students will have experience working within the project team during the planning of the project, they will understand problems of the organization of the project team, interaction with users, schedules and budgets, risk management.</td>
</tr>
<tr>
<td><strong>Theoretical teaching</strong></td>
<td>Team project organization.</td>
</tr>
<tr>
<td><strong>Practical teaching (exercises, OFE, study and research work)</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Number of classes of active education per week during semester/trimester/year</strong></td>
<td>Lectures</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td><strong>Teaching methods</strong></td>
<td>Lectures, auditive exercises, homework, team projects.</td>
</tr>
<tr>
<td><strong>Grade (maximum number of points 100)</strong></td>
<td>activity during lectures</td>
</tr>
<tr>
<td></td>
<td>exercises</td>
</tr>
<tr>
<td></td>
<td>colloquia</td>
</tr>
<tr>
<td></td>
<td>projects</td>
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</tbody>
</table>
### Specification for the book of courses

<table>
<thead>
<tr>
<th>Study program</th>
<th>Computing and Informatics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Module</td>
<td>All moduls</td>
</tr>
<tr>
<td>Type and level of studies</td>
<td>MSc</td>
</tr>
<tr>
<td>The name of the course</td>
<td>Introduction to Scientific Research</td>
</tr>
<tr>
<td>Lecturer (for lectures)</td>
<td>Stanković M. Milena</td>
</tr>
<tr>
<td>Lecturer/associate (for exercises)</td>
<td>Jovanović D. Martin</td>
</tr>
<tr>
<td>Lecturer/associate (for OFE)</td>
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</tr>
<tr>
<td>Number of ECTS</td>
<td>4</td>
</tr>
<tr>
<td>Course status (obligatory/elective)</td>
<td>elective</td>
</tr>
<tr>
<td>Prerequisites</td>
<td></td>
</tr>
<tr>
<td><strong>Course objectives</strong></td>
<td>The main goal of this course is to introduce student in all aspects of scientific research including: searching and use of relevant literature, define a problem and implementation of the research, analyze and discussion of the results and presentation of the results.</td>
</tr>
<tr>
<td><strong>Course outcomes</strong></td>
<td>Students will acquire the knowledge needed to be involved in scientific research. They will know how to select relevant literature, how to formulate own ideas and to define the starting hypothesis for research. Also, they will know to evaluate and to present the results of the research.</td>
</tr>
<tr>
<td><strong>Course outline</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Theoretical teaching</strong></td>
<td>Scientific approach to solving problems, ideas, resources and ethical aspects. Searching end use of relevant literature. Formulation of the problem and definition of the hypothesis. The methodology of the scientific research. Data acquisition, surveys and questionnaires. Experimental research. Statistical methods for evaluation of the research results. Evaluation and comparison of the research results. Preparation of the scientific papers, correct referencing on the used literature. Presentation of the research results.</td>
</tr>
<tr>
<td><strong>Practical teaching</strong></td>
<td>Preparation of the scientific paper related to the selected scientific field.</td>
</tr>
<tr>
<td>(exercises, OFE, study and research work)</td>
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<tr>
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<td>Entrepreneurship and Planning in High Technologies</td>
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<td>Milentijević Z. Ivan, Tošić B. Milorad</td>
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<tr>
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<td>To familiarize students with basic concepts of entrepreneurship, to explore the capabilities of commercialization of the technology idea, primarily software or hardware products or IT services, and to gain basic experience in creating of business plan and budget planning for IT business venture.</td>
</tr>
<tr>
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<td>Students will be able to: assess the technological ideas, explore business opportunities for particular idea, and create a business plan.</td>
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<td>Course outcomes</td>
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<td>Practical teaching (exercises, OFE, study and research work)</td>
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<tr>
<td></td>
<td>2 Guy Kawasaki, The Art of the Start, Must Read Summaries (2011)</td>
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<td>3 Karen Gadd, TRIZ For Engineers: Enabling Inventive Problem Solving, Wiley (2011)</td>
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#### Course status (obligatory/elective)
- obligatory

#### Prerequisites
- Introduction to the process of work in a company in which the student is practiced, its objectives and its organizational units. Getting to know the team and the project in which the students within their professional practice connected and selected in accordance with the electoral area of study (modules) for which the student has opted for. Understanding the process of the enterprise, business processes, understanding of the risks in their work, participate in the design, documentation and quality control, in accordance with the process of working environment and opportunities.

#### Course objectives
- Improving the ability of the student to study at the end of the work involved in the process. Being responsible, professional approach, communication skills in a team. Complement the theoretical knowledge gained in the study of knowledge and practical problem which is studied in the framework of study that the student attends. Using the experience of experts employed at the facility where the practice is done to extend the practical knowledge and motivation of students. Gaining a clear insight into the possibility of applying the acquired knowledge and skills covered by the study program in practice.

#### Course outcomes
- Content of professional practice is in full compliance with the goals of practice. To learn basic structure of the company and its business goals, adapting his own involvement in the study area, which is decided and duly fulfills the work obligation in accordance with the duties and responsibilities of a team of employees in the company. Student describes his own involvement in professional practice and provides a critical review on their own experience, knowledge and skills they have gained in practice.

#### Course outline

##### Theoretical teaching

##### Practical teaching (exercises, OFE, study and research work)

- Students are organized into teams and compete in the topics offered to them. Themes are defined by firms/companies (whose work relates to Computer Science), or by the laboratory of the faculty/department, with specified objectives, expected performance and goals. Topics have mentors from the company and the faculty mentor. Vocational training may be conducted abroad, in which case the student, among other things improved and foreign language. Allocation of topics for student teams practice made head of the course module, and issue a written referral to the professional practice of student team performance practice at the institution. Upon completion of the implementation of practices, based on the report team of students and the confirmation of the responsible person signature and company stamp confirms that the practice is done, the students present the results of a public presentation of their work and they are assigned a 3 ECTS credits for the work carried out in professional practice.

#### Textbooks/references

1. [Computing and Informatics](#)
2. [Study program manager](#)
3. [Lecturer (for lectures)](#)
4. [Lecturer/associate (for exercises)](#)
5. [Lecturer/associate (for OFE)](#)

#### Number of classes of active education per week during semester/trimester/year

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<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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#### Teaching methods

#### Grade (maximum number of points 100)

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<td>projects</td>
<td>70</td>
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</table>
### Prerequisites

The application of basic theoretical, methodological, scientific, technical and professional application of knowledge and methods to solve practical problems. Students studied the problem, and the complexity of its structure and based on the conclusions of the analysis performed on possible ways of solving it.

### Course objectives

Training students to independently apply previously acquired knowledge in different areas that are studied, in order to review the structure of the given problem and its system analysis in order to draw conclusions on possible directions for its resolution. Through the use of literature and independent laboratory work, students expand their knowledge by studying different methods relating to similar issues. In this way, the students develop the ability to conduct analysis and identify problems in the field of computer science. Practical application of acquired knowledge in students develops the ability to look at the place and role of engineers in the chosen field, the need to cooperate with other professions and teamwork.

### Course outcomes

Formed in accordance with the individual needs of the subjects of the first semester master academic studies, their complexity and structure. Part of teaching the subjects is conducted through independent study research and teaching of the laboratory work. Student according to their preferences and inclinations chosen field of study or subject teacher with a list of teachers in the study program, which he defines the specific task. The student learns to samostallno river bank of scientific and technical information from various sources. Acquire an awareness of the reliability of scientific and technical information. Special attention is paid to the use of literature, bibliographic databases, and research methods. Study work includes: active monitoring of primary knowledge, organization, and supervised conduct of research, statistical analysis of data, the implementation of tasks in the lab, seminar work in the immediate area of science teaching which belongs to independent research topics (Software Engineering, Computer Engineering, Information Technology, Computer Security systems or information systems).

### Practical teaching (exercises, OFE, study and research work)

Practical teaching is done depending on the chosen teaching specific scientific field to which it belongs issue of independent research (Software Engineering, Computer Engineering, Information Technology, Computer Systems Security and Information Systems), and in accordance with a defined task. In the practical classes students can take part in the implementation of tasks in the laboratory, in the preparation of the paper, to participate in seminars, panel discussions and other activities that present the results of their work.

### Textbooks/References

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<tr>
<th>Textbooks/references</th>
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### Number of classes of active education per week during semester/trimester/year

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### Teaching methods

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<td>from the ranks of teachers, student tries as independently solve the given task and prepare the written and the oral defense. Student's independent work is estimated to be 15 ECTS.</td>
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### Prerequisites

<table>
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<th>Course status (obligatory/elective)</th>
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### Course objectives

The application of basic theoretical, methodological, scientific, technical and professional application of knowledge and methods to solve practical problems. Students studied the problem, and the complexity of its structure and based on the conclusions of the analysis performed on possible ways of solving it.

### Course outcomes

Training students to independently apply previously acquired knowledge in different areas that are studied, in order to review the structure of the given problem and its system analysis in order to draw conclusions on possible directions for its resolution. Through the use of literature and individual laboratory work, students expand their knowledge by studying different methods relating to similar issues. In this way, the students develop the ability to conduct analysis and identify problems in the field of computer science. Practical application of acquired knowledge in students develop the ability to look at the place and role of engineers in the chosen field, the need to cooperate with other professions and teamwork.

### Course outline

Formed in accordance with the individual needs of the subject of the second semester master academic studies, their complexity and structure as well as the preparation of a master work. Part of teaching the subjects is conducted through independent study research and teaching of the laboratory work. Student according to their preferences and inclinations chosen field of study or subject teacher with a list of teachers in the study program, which he defines the specific task. The student learns to samostallno river bank of scientific and technical information from various sources. Acquire an awareness of the reliability of scientific and technical information. Special attention is paid to the use of literature, bibliographic databases, and research methods. Studio work includes: active monitoring of primary knowledge, organization, and supervised conduct of research, statistical analysis of data, the implementation of tasks in the lab, seminar work in the immediate area of science teaching which belongs to independent research topics (Software Engineering, Computer Engineering, Information Technology, Computer Security systems or information systems). Preparing for the preparation of graduate work.

### Theoretical teaching

Practical teaching is done depending on the chosen teaching specific scientific field which belongs to independent research topics and themes of the master (Software Engineering, Computer Engineering, Information Technology, Computer Systems Security and Information Systems), and in accordance with a defined task. In the practical classes students can take part in the implementation of tasks in the laboratory, in the preparation of the paper, to participate in seminars, panel discussions and other activities that present the results of their work. Preparing for the preparation of graduate work.

### Textbooks/references

1
2
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### Number of classes of active education per week during semester/trimester/year

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<thead>
<tr>
<th>Lectures</th>
<th>Exercises</th>
<th>OFE</th>
<th>Study and research work</th>
<th>Other classes</th>
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### Teaching methods

<table>
<thead>
<tr>
<th>Grade (maximum number of points 100)</th>
<th>Pre-exam duties</th>
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<tr>
<td>activity during lectures</td>
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<tr>
<td>exercises</td>
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<td>oral exam</td>
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<td>colloquia</td>
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<tr>
<td>projects</td>
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