UNIVERSITY OF BANJA LUKA
FACULTY OF ELECTRICAL ENGINEERING

“PhD in Information and Communication Technology”

MODULES AND COURSES

Banja Luka, May 2016
**CURRICULUM**

Important: All courses are elective. By choosing one profile, the courses of that module become mandatory and they are marked as “Main module course” in the table, while courses that student chooses from other modules are marked as “Elective course”. Independent student’s work is not included in the number of research hours stated in the table, but only the work with the mentor.

<table>
<thead>
<tr>
<th>No</th>
<th>COURSE</th>
<th>semester</th>
<th>ECTS</th>
<th>Hours per week</th>
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<tbody>
<tr>
<td>1</td>
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<td>I</td>
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<td>2</td>
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<tr>
<td>6</td>
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<td>9</td>
<td>Main module course/</td>
<td>II</td>
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<td>II</td>
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<tr>
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<td>Research</td>
<td>VI</td>
<td>30</td>
<td>25</td>
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<tr>
<td></td>
<td><strong>Total VI semester</strong></td>
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<td>30</td>
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## Modules, Courses and Lecturers

<table>
<thead>
<tr>
<th>Module</th>
<th>Course Title</th>
<th>Name of the Lecturer</th>
</tr>
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<tbody>
<tr>
<td><strong>Software Technologies</strong></td>
<td>Model Driven Software Development</td>
<td>Dr. Dražen Brđanin, Assistant Professor</td>
</tr>
<tr>
<td></td>
<td>Advanced Concepts in Databases</td>
<td>Prof. Dr. Slavko Marić, Full Professor</td>
</tr>
<tr>
<td></td>
<td>Selected Topics in Internet Programming</td>
<td>Prof. Dr. Zoran Đurić, Associate Professor</td>
</tr>
<tr>
<td></td>
<td>Scientific Computing</td>
<td>Prof. Dr. Momir Ćelić, Full Professor</td>
</tr>
<tr>
<td><strong>Software Engineering</strong></td>
<td>Multimedia Security Operating Systems</td>
<td>Prof. Dr. Ratko Dejanović, Full Professor</td>
</tr>
<tr>
<td></td>
<td>Graph Theory</td>
<td>Dr. Duško Jojić, Assistant Professor</td>
</tr>
<tr>
<td></td>
<td>Component-Based Software Engineering</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td></td>
<td>Simulation</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td><strong>Multimedia</strong></td>
<td>Advanced Multimedia Processing</td>
<td>Prof. Dr. Zdenka Babić, Full Professor</td>
</tr>
<tr>
<td></td>
<td>Multimedia Information Retrieval and Management</td>
<td>Dr. Vladimir Risojević, Assistant professor</td>
</tr>
<tr>
<td></td>
<td>Artificial Intelligence</td>
<td>Prof. Dr. Milorad Božić, Full Professor</td>
</tr>
<tr>
<td></td>
<td>Multi- and many-core processors for multimedia</td>
<td>Prof. Dr. Patricio Bulić, Associate Professor</td>
</tr>
<tr>
<td><strong>Communications</strong></td>
<td>Internet of Things Technologies and Applications</td>
<td>Prof. Dr. Gordana Gardašević, Associate Professor</td>
</tr>
<tr>
<td></td>
<td>Advanced Topics in Internet Technologies</td>
<td>Dr. Pavle Vuletić, Assistant Professor</td>
</tr>
<tr>
<td></td>
<td>Cryptography and Computer Systems Security</td>
<td>Prof. Dr. Zoran Djurić, Associate Professor</td>
</tr>
<tr>
<td></td>
<td>Speech Processing and Transmission</td>
<td>Prof. Dr. Vlado Delić, Full Professor</td>
</tr>
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</table>

### Elective courses:

<table>
<thead>
<tr>
<th>Course</th>
<th>Lecturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robot Vision</td>
<td>Prof. Dr. Petar Marić, Full Professor</td>
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</table>
“PhD in Information and Communication Technology”

MODULES AND COURSES
## MODULE DESCRIPTION

<table>
<thead>
<tr>
<th>Module letter and title</th>
<th>Course number and title</th>
<th>No. of ECTS</th>
<th>Visiting lecturer</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Software Technologies</td>
<td>1 Model Driven Software Development</td>
<td>6</td>
<td>no</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2 Advanced Concepts in Databases</td>
<td>6</td>
<td>no</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3 Selected Topics in Internet Programming</td>
<td>6</td>
<td>no</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4 Scientific Computing</td>
<td>6</td>
<td>no</td>
<td>2</td>
</tr>
</tbody>
</table>

**Objectives (Competences):**

The students are to become acquainted with fundamental procedures for the construction of large software systems. They will become familiar with tools and techniques for building complex applications and learn about the advantages and disadvantages of formal and informal specification techniques, as well as tuning and improving. They also will be become familiar with scientific computing tools in research.
<table>
<thead>
<tr>
<th>Module letter and title</th>
<th>Course number and title</th>
<th>No. of ECTS</th>
<th>Visiting lecturer</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td>B Software Engineering</td>
<td>5 Multimedia Security Operating Systems</td>
<td>6</td>
<td>no</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>6 Graph Theory</td>
<td>6</td>
<td>no</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>7 Component-Based Software Engineering</td>
<td>6</td>
<td>yes</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>8 Simulation</td>
<td>6</td>
<td>yes</td>
<td>2</td>
</tr>
</tbody>
</table>

**Objectives (Competences):**

After fulfilling the module, the student should be able to analyze complex system properties in different technologies and give a specific problem based solutions. They also will have full understanding of mathematical methods connected to computer science and their impact on the theory of algorithms.
<table>
<thead>
<tr>
<th>Module letter and title</th>
<th>Course number and title</th>
<th>No. of ECTS</th>
<th>Visiting lecturer</th>
<th>Semester</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 Advanced Multimedia Processing</td>
<td>6</td>
<td>no</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>10 Multimedia Information Retrieval and Management</td>
<td>6</td>
<td>no</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>11 Artificial Intelligence</td>
<td>6</td>
<td>no</td>
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</tr>
<tr>
<td></td>
<td>12 Multi- and many-core processors for multimedia</td>
<td>6</td>
<td>yes</td>
<td>2</td>
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</tbody>
</table>

**Objectives (Competences):**

At the end of this module students are expected to have deep knowledge of recent advances in multimedia processing, artificial intelligence and robotics, ability to recognize and validate problems in this scientific field, as well as to demonstrate original, independent and critical analysis. They will become acquainted with relevant research methodologies, techniques and applications in multimedia.
<table>
<thead>
<tr>
<th>Module letter and title</th>
<th>Course number and title</th>
<th>No. of ECTS</th>
<th>Visiting lecturer</th>
<th>Semester</th>
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<tbody>
<tr>
<td>D Communications</td>
<td>13 Internet of Things Technologies and Applications</td>
<td>6</td>
<td>no</td>
<td>1</td>
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<tr>
<td></td>
<td>14 Advanced Topics in Internet Technologies</td>
<td>6</td>
<td>yes</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>15 Cryptography and computer systems security</td>
<td>6</td>
<td>no</td>
<td>2</td>
</tr>
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<td></td>
<td>16 Speech Processing and Transmission</td>
<td>6</td>
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</table>

Objectives (Competences):

The objective of this module is to overcome the gap between the existing state and actual needs in wireless communication, internet technologies and security in ICT.
## Course Syllabus

<table>
<thead>
<tr>
<th>Course Title:</th>
<th>Model Driven Software Development</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course is</td>
<td>modified □ new □</td>
</tr>
<tr>
<td>Explain relation between workload and ECTS credits:</td>
<td>6 ECTS</td>
</tr>
<tr>
<td></td>
<td>26 hours lectures, 13 hours tutorial, 6 hours of other contact activities and 135 hours of individual work</td>
</tr>
<tr>
<td>Course Date:</td>
<td>(term and dates if already known):</td>
</tr>
<tr>
<td>Lecturer:</td>
<td>Lecturer’s name: Dr. Dražen Brđanin, Assistant Professor</td>
</tr>
<tr>
<td></td>
<td>Office location: University of Banja Luka, Faculty of Electrical Engineering, Patre 5, 78000 Banja Luka, BiH</td>
</tr>
<tr>
<td></td>
<td>Office hours: Working day 10:00 – 14:00 or on appointment</td>
</tr>
<tr>
<td></td>
<td>Phone: +387 51 221 851</td>
</tr>
<tr>
<td></td>
<td>email address: <a href="mailto:bdrazen@etfbl.net">bdrazen@etfbl.net</a></td>
</tr>
<tr>
<td>Course Type</td>
<td>Lecture</td>
</tr>
<tr>
<td>Format</td>
<td>block course</td>
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<tr>
<td>Content Description:</td>
<td>The lecture gives an overview over the different methods for model driven software development. The theoretical knowledge is practiced in tutorials and assignments also with the help of practice-relevant tools (e.g. Together, UPPAAL or SPIN).</td>
</tr>
<tr>
<td>Assessment Modalities:</td>
<td>examination</td>
</tr>
</tbody>
</table>
### Learning Outcomes:
(show how course contributes to objectives of the module)

The students are to become acquainted with fundamental procedures for the construction of large software systems as well as to learn working with practice-relevant tools (e.g. Together, UPPAAL or SPIN), learn about the advantages and disadvantages of formal and informal specification techniques and to realize the necessity for design and abstract representation (specification) for the improvement of the software quality. In particular the paradigm of "Model Driven Development" (also: Model Driven Architecture), which is postulated in the surrounding field of the UML, is explained.

### Teaching Methods:
Please state how the course will be taught.

Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)

Lectures, assignments and tutorials

### Required/recommended Literature
(include publication details)

<table>
<thead>
<tr>
<th>Required book(s)</th>
<th>Recommended book(s)</th>
<th>Journals or other material</th>
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# Course Syllabus

<table>
<thead>
<tr>
<th>Course Title:</th>
<th>Advanced Concepts in Databases</th>
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</thead>
<tbody>
<tr>
<td>Course is</td>
<td>modified □ new □</td>
</tr>
</tbody>
</table>
| Explain relation between workload and ECTS credits: | 6 ECST  
45 contact hours and 135 hours of students’ individual work |
<p>| Course Date: (term and dates if already known): | |
| Lecturer: | Lecturer’s name: Prof. Dr. Slavko Marić, Full Professor |
|            | Office location: University of Banja Luka, Faculty of Electrical Engineering, Patre 5, 78000 Banja Luka, BiH |
|            | Office hours: Working day 10:00 – 14:00 or on appointment |
|            | Phone: +387 51 221 840 |
|            | email address: <a href="mailto:ms@etfbl.net">ms@etfbl.net</a> |
| Course Type (e.g. seminar, lecture, lab sessions, etc.) | Lecture+seminar+lab sessions. |
| Format (e.g. once per week, block course, etc. – specify number of course sessions) | Once per week and partly block course |
| Content Description: | The content of the course will cover the topics at the intersection of database system, operating system, and distributed and parallel computing research and development. The concepts and theory, as well as practice of transaction processing will be studied in details. The effect of different parameters and interaction of different levels of the system on database application performance will be explored (e.g., index design and concurrency control), and database tuning will be discussed from the hardware to conceptual design, touching on operating systems, transactional subcomponents, index selection, query |</p>
<table>
<thead>
<tr>
<th><strong>Learning Outcomes:</strong> (show how course contributes to objectives of the module)</th>
<th>One of the main components of the majority of applications based on ICT technologies are databases. After long period of development of the RDBMS’s and accompanying development tools and other supporting software, it’s possible to design and develop in technically relatively simple way, robust software systems that work correctly in environments with many concurrent users, that are resistant and recoverable from system breakdowns, etc. Often, these application systems put high demands on the speed and throughput of the system. The goal of this course is to study the internals of database systems as an introduction to research and as a basis for rational performance tuning and improving in complex database applications.</th>
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</thead>
<tbody>
<tr>
<td><strong>Assessment Modalities:</strong></td>
<td>Homework Problem Solving (40%), project (60%).</td>
</tr>
<tr>
<td><strong>Teaching Methods:</strong> Please state how the course will be taught. Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)</td>
<td>This course will be taught using a variety of teaching methods including lectures, class discussions, team work, project creation.</td>
</tr>
<tr>
<td>Journals or other material</td>
<td></td>
</tr>
<tr>
<td>----------------------------</td>
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| ISBN: 1558601902  
### Course Syllabus

<table>
<thead>
<tr>
<th>Course Title:</th>
<th>Selected Topics in Internet Programming</th>
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</thead>
<tbody>
<tr>
<td>Course is</td>
<td>modified □ new □</td>
</tr>
</tbody>
</table>
| **Explain relation between workload and ECTS credits:** | 6 ECTS  
45 hours of contact hours and 135 hours of students’ individual work |
| **Course Date:**  
(term and dates if already known): | - |
| **Lecturer:** |  
**Lecturer’s name:** Prof. Dr. Zoran Đurić, Associate Professor  
**Office location:** Banja Luka  
**Office hours:** Working day 10:00 – 14:00 or on appointment  
**Phone:** +387 51 221 839  
**email address:** zoran@spinter.net |
| **Course Type**  
(e.g. seminar, lecture, lab sessions, etc.) | Lecture + seminar + lab sessions |
| **Format**  
(e.g. once per week, block course, etc. – specify number of course sessions) | - once per week |
| **Content Description:** | This course will take participants through the most important issues in Internet programming, including concurrent programming, databases, security, collaborative computing, distributed object-oriented architectures, network publishing, Web technologies, architectures, frameworks, and languages that are used to deliver modern dynamic Web sites and rich Internet applications. Participants will study tools and techniques for building Internet applications, including CGI programming, XML, XSLT, servlets, JSP, JSF, CSS, JavaScript, SOA, Web services, and AJAX. Participants will learn how to develop applications for a |
variety of Web clients, including mobile clients.

| Assessment Modalities: | - Solving homework problems - 40%
| - Project - 40%
| - Final Exam – 20% |

| Learning Outcomes: (show how course contributes to objectives of the module) | After completing this course, participants will be able:
| - To analyze and define specifications of an Internet application
| - To design, develop and code interactive Internet applications with more than one Internet application programming language,
| - To develop applications for a variety of Web clients, including mobile clients, using various tools and techniques,
| - To design, develop and code server-side programs. |

| Teaching Methods: Please state how the course will be taught. | - Lectures
| - Class discussions
| - Labs
| - Team work
| - Project creation
| - Email and website discussions |

| Required/ recommended Literature (include publication details) | Required book(s)
| - Core WEB Programming Volume 2, by Hall and Brown; Prentice Hall
| - J. Mc Govern, S. Tyagi, M. Stevens, S. Mathew - Java WEB Service Architecture |

| Recommended book(s) | - Java Web Development Illuminated by Qian, Allen, Gan and Brown; Jones and Bartlett Publishers ISBN 978-0-7637-3423-7 |

| Journals or other material | [http://jsp.org/en/home/index](http://jsp.org/en/home/index) 
<table>
<thead>
<tr>
<th>Course Title:</th>
<th>Scientific Computing</th>
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</thead>
<tbody>
<tr>
<td>Course is</td>
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<tr>
<td>Explain relation between workload and ECTS credits:</td>
<td>6 ECST</td>
</tr>
<tr>
<td></td>
<td>45 hours of contact hours and 135 hours of students’</td>
</tr>
<tr>
<td></td>
<td>individual work</td>
</tr>
<tr>
<td>Course Date:</td>
<td></td>
</tr>
<tr>
<td>(term and dates if already known):</td>
<td></td>
</tr>
<tr>
<td>Lecturer:</td>
<td></td>
</tr>
<tr>
<td>Lecturer’s name:</td>
<td>Prof. Dr. Momir Celić, Full Professor</td>
</tr>
<tr>
<td>Office location:</td>
<td>University of Banja Luka, Faculty of Electrical</td>
</tr>
<tr>
<td></td>
<td>Engineering, Patre 5, 78000 Banja Luka, BiH</td>
</tr>
<tr>
<td>Office hours:</td>
<td>Working day 10:00 – 14:00 or on appointment</td>
</tr>
<tr>
<td>Phone:</td>
<td>+38751221831</td>
</tr>
<tr>
<td>email address:</td>
<td><a href="mailto:mcelic@etfbl.net">mcelic@etfbl.net</a></td>
</tr>
<tr>
<td>Course Type (e.g. seminar, lecture, lab sessions, etc.)</td>
<td>lecture</td>
</tr>
<tr>
<td>Format (e.g. once per week, block course, etc. – specify number of course sessions)</td>
<td>once per week</td>
</tr>
<tr>
<td>Content Description:</td>
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<tr>
<td>Introduction to scientific computing</td>
<td></td>
</tr>
<tr>
<td>Systems of linear equations</td>
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<tr>
<td>Linear least squares</td>
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<td>Eigenvalue problem</td>
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<td>Nonlinear equations</td>
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<td>Optimization</td>
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<td>Interpolation</td>
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<tr>
<td>Numerical integration</td>
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<tr>
<td>Ordinary differential equations</td>
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</tr>
<tr>
<td>Assessment Modalities:</td>
<td>examination</td>
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<tr>
<td>------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td><strong>Learning Outcomes:</strong> (show how course contributes to objectives of the module)</td>
<td>After this course student will be familiar with all the major problems in scientific computing and will be able to use numerical algorithms and software in their research.</td>
</tr>
<tr>
<td><strong>Teaching Methods:</strong> Please state how the course will be taught. Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)</td>
<td>This course is taught using a variety of teaching methods including lectures, class discussions and project creation</td>
</tr>
<tr>
<td></td>
<td>Journals or other material</td>
</tr>
<tr>
<td><strong>Course Syllabus</strong></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Course Title:</strong></td>
<td>Multimedia Security Operating Systems</td>
</tr>
<tr>
<td><strong>Course is</strong></td>
<td>modified □ new □</td>
</tr>
<tr>
<td><strong>Explain relation between workload and ECTS credits:</strong></td>
<td>6 ECST includes: 26 lecture hours, 19 contact hours for project realization and 135 hours of individual work</td>
</tr>
<tr>
<td><strong>Course Date:</strong></td>
<td>(term and dates if already known): -</td>
</tr>
<tr>
<td><strong>Lecturer:</strong></td>
<td>Lecturer’s name: Prof. dr. Ratko Dejanović, Full Professor</td>
</tr>
<tr>
<td></td>
<td>Office location: University of Banja Luka, Faculty of Electrical Engineering, Patre 5, 78000 Banja Luka, BiH</td>
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<td></td>
<td>Office hours: Working day 10:00 – 14:00 or on appointment</td>
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<tr>
<td></td>
<td>Phone: +38751 221842</td>
</tr>
<tr>
<td></td>
<td>email address: <a href="mailto:ratko@etfbl.net">ratko@etfbl.net</a></td>
</tr>
<tr>
<td><strong>Course Type</strong></td>
<td>Lecture/seminar</td>
</tr>
<tr>
<td><strong>Format</strong></td>
<td>lectures – 13 sessions, projects</td>
</tr>
<tr>
<td><strong>Content Description:</strong></td>
<td>Lecture/seminar considers Modern Operating systems focuses on Multimedia Security OS, topics like multimedia files, multimedia process scheduling, multimedia file system paradigms, file placement, caching, disk scheduling for multimedia.</td>
</tr>
<tr>
<td><strong>Assessment Modalities:</strong></td>
<td>examination</td>
</tr>
</tbody>
</table>
### Learning Outcomes:
(show how course contributes to objectives of the module)

At the end of this course students will be able to:
- Deeply understand the principle and recent advances in Multimedia Security Operating Systems;
- Describe the principles underlying both multimedia and security;
- Discuss the main problems and approaches in this area;
- Find a suitable OS solution for complex multimedia and security problems.

### Teaching Methods:
Please state how the course will be taught.

Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)

The course is taught using lectures, discussing, team work and project creation. The team work focuses on work in small groups on the part of project and their collaboration each to other for whole project.

Copies of project requirements papers will be distributed to the students

|--------------------------------------------------------------|------------------|--------------------------------------------------------------------------------|
# Course Syllabus

<table>
<thead>
<tr>
<th>Course Title:</th>
<th>Graph Theory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course is</td>
<td>modified □</td>
</tr>
<tr>
<td>new □</td>
<td></td>
</tr>
<tr>
<td>Explain relation between workload and ECTS credits:</td>
<td>6 ECTS</td>
</tr>
<tr>
<td></td>
<td>24 hours lectures, 10 hours tutorial, 11 hours of other contact activities and 135 hours of individual work</td>
</tr>
<tr>
<td>Course Date: (term and dates if already known):</td>
<td>-</td>
</tr>
<tr>
<td>Lecturer:</td>
<td>Dr. Duško Jojić, Assistant Professor</td>
</tr>
<tr>
<td></td>
<td>Office location:</td>
</tr>
<tr>
<td></td>
<td>Office hours:</td>
</tr>
<tr>
<td></td>
<td>Phone:</td>
</tr>
<tr>
<td></td>
<td>email address: <a href="mailto:ducci68@teol.net">ducci68@teol.net</a></td>
</tr>
<tr>
<td>Course Type (e.g. seminar, lecture, lab sessions, etc.):</td>
<td>Lecture/seminar</td>
</tr>
<tr>
<td>Format (e.g. once per week, block course, etc. – specify number of course sessions):</td>
<td>Once per week 2 hours lecture plus 2 hours seminar using GrInvIn (this is an interactive software application for studying graphs and their invariants) Planned as Block course in Banjaluka.</td>
</tr>
<tr>
<td>Content Description:</td>
<td>The first part of the lecture/seminar considers graph theoretical topics like trees, matching, flows (circulations), connectivity, recursive structures of some graph classes, colorings, and touches some aspects of topological graph theory (embeddings; minors), as well as parts of external graph theory. The last part focuses on algorithmic aspects, the complexity of some decision problems, and gives a short introduction to the algorithmic consequences of the Robertson/Seymour graph minor theory.</td>
</tr>
<tr>
<td>Assessment Modalities:</td>
<td>examination</td>
</tr>
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</tr>
<tr>
<td><strong>Learning Outcomes:</strong></td>
<td>The students will have full understanding of graph theoretical notions, their connection to theoretical computer science and their impact on the theory of algorithms. Furthermore they will be proficient in using graph theoretical methods.</td>
</tr>
<tr>
<td>(show how course contributes to objectives of the module)</td>
<td></td>
</tr>
<tr>
<td><strong>Teaching Methods:</strong></td>
<td>The course is taught using lectures, discussing and team work. The team work focuses on the use of GrInvIn (this is an interactive software application for studying graphs and their invariants). Given some graphs and a main invariant (for each student group where each group consists of two students) as input, GrInvIn creates graph theoretical conjectures. Each group has to prove the conjecture or to disprove it by giving a minimum counter-example. I have used this teaching approach before, and it led to an active student discussion about graph theoretical questions. Since the course is taught as a block course it will have lectures (2 hours) and practical work for the students (GrInvIn) (2 hours) alternately, i.e. 2 lect + 2 GrInvIn + 2 lect + 2 GrInvIn (total 8 hours per day)</td>
</tr>
<tr>
<td>Please state how the course will be taught.</td>
<td>Copies of required original papers will be distributed to the students</td>
</tr>
<tr>
<td><strong>Required/recommended Literature</strong></td>
<td>Required book(s)</td>
</tr>
<tr>
<td>Journals or other material</td>
<td>Journal Combinatorial Theory (Ser. B), Combinatorica, Journal Graph Theory, Discrete Mathematics, Discrete Applied Mathematics, Graphs and Combinatorics</td>
</tr>
</tbody>
</table>
## Course Syllabus

<table>
<thead>
<tr>
<th>Course Title:</th>
<th>Component-Based Software Engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course is</td>
<td>modified □ new □</td>
</tr>
<tr>
<td>Explain relation between workload and ECTS credits:</td>
<td>6 ECTS 16 hours of lectures, 29 hours of technical reports, seminars and other contact activities and 135 hours of individual work</td>
</tr>
<tr>
<td>Course Date: (term and dates if already known):</td>
<td></td>
</tr>
<tr>
<td>Lecturer:</td>
<td>Lecturer’s name:</td>
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<tr>
<td></td>
<td>Office location:</td>
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<tr>
<td></td>
<td>Office hours:</td>
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<tr>
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<td>Phone:</td>
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<tr>
<td></td>
<td>email address:</td>
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<tr>
<td>Course Type (e.g. seminar, lecture, lab sessions, etc.)</td>
<td>Lectures+seminars</td>
</tr>
<tr>
<td>Format (e.g. once per week, block course, etc. – specify number of course sessions)</td>
<td>Block course – two blocks + 2 seminars</td>
</tr>
<tr>
<td>Content Description:</td>
<td>The lecture gives an overview of software engineering methods for development of component-based systems. An overview of the following topics is given: different component models and technologies, component-based development processes, component compositions: components inter-operability and composition of non-functional properties.</td>
</tr>
<tr>
<td>Assessment Modalities:</td>
<td>Project work including a state of the art report</td>
</tr>
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<td>------------------------</td>
<td>-------------------------------------------------</td>
</tr>
<tr>
<td><strong>Learning Outcomes:</strong></td>
<td>Advanced knowledge about modelling and designing component-based software systems in different domains, in particular component models for embedded systems. Overview of different component-based technologies. Quality requirements and composition of quality attributes in component-based systems.</td>
</tr>
<tr>
<td><strong>Teaching Methods:</strong></td>
<td>Lectures, assignments, project works and project presentations</td>
</tr>
<tr>
<td><strong>Required/ recommended Literature</strong></td>
<td></td>
</tr>
<tr>
<td>Required book(s)</td>
<td>Ivica Crnkovic and Magnus Larsson, Building Reliable Component-Based Software Systems. - Artech House Publishers</td>
</tr>
<tr>
<td>Recommended book(s)</td>
<td>Ivica Crnkovic, Magnus Larsson, Otto Preiss, Concerning Predictability in Dependable Component-Based Systems: Classification of Quality Attributes, Architecting Dependable Systems III, p pp. 257 – 278, Springer, LNCS 3549, Editor(s): R. de Lemos et al. (Eds.); 2005</td>
</tr>
<tr>
<td>Journals or other material</td>
<td>Ivica Crnkovic, Michel Chaudron, Stig Larsson Component-based Development Process and Component Lifecycle, Pages, Journal of Computing and Information Technology, vol 13, nr 4, p321-327, University Computer Center, Zagreb, November, 2005</td>
</tr>
<tr>
<td>Scott Hissam, Gabriel Moreno, Judith Stafford, &amp; Kurt Wallnau.  Packaging Predictable Assembly with Prediction-Enabled Component Technology (CMU/SEI-2001-TR-024).</td>
<td></td>
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</table>
## Course Syllabus

<table>
<thead>
<tr>
<th>Course Title:</th>
<th>Simulation</th>
</tr>
</thead>
</table>
| Explain relation between workload and ECTS credits: | 6 ECTS  
24 hours lectures, 10 hours tutorial, 11 hours other contact activities, 135 hours of individual work |
| Course Date: (term and dates if already known): | - |
| Lecturer: | Lecturer’s name: |
| | Office location: |
| | Office hours: |
| | Phone: |
| | email address: |
| Office location: | |
| Office hours: | |
| Phone: | |
| email address: | |
| Course Type (e.g. seminar, lecture, lab sessions, etc.): | Lecture/seminar |
| Format (e.g. once per week, block course, etc. – specify number of course sessions): | Once per week 2 hours lecture plus 2 hours seminar for practical approach (existing, interactive software for material flow simulation can be used)  
Planned as Block course in Banjaluka |
| Content Description: | The first part of the lecture gives an overview on simulation topics, methods and application areas, e.g. Monte-Carlo Simulation in the finance area.  
Afterwards, the course as well as the assigned seminar will focus on the discrete, event-oriented material flow simulation, with focus on theory as well as application for management as well as simulation experts (experimental design, simulation study procedure model, etc.) |
| Assessment Modalities: | examination |
**Learning Outcomes:**
(show how course contributes to objectives of the module)

The students will have an overview about simulation methods, techniques as well as their specific application areas and fundamental knowledge about the discrete, event-oriented simulation, applicable for the design, control and improvement for material flows. Furthermore, they are able to use and refine the most known tools in this area: graphic oriented simulation tools, based on existing building blocks.

**Teaching Methods:**
Please state how the course will be taught.

Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)

The course is taught using lectures, discussing and team work. The team work will focus on the practical part in the seminar. Groups of students are to work on specific areas, dealt with in the lecture part. Since the course is taught as a block course it will have lectures (2 hours) and practical work for the students (2 hours) alternately, i.e. 2 lect + 2 seminar + 2 lect + 2 seminar (total 8 hours per day)

<table>
<thead>
<tr>
<th><strong>Required/recommended Literature</strong> (include publication details)</th>
<th><strong>Required book(s)</strong></th>
<th><strong>Recommended book(s)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Recommended book(s)</td>
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</tr>
<tr>
<td></td>
<td>Journals or other material</td>
<td>-</td>
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</tbody>
</table>
# Course Syllabus

<table>
<thead>
<tr>
<th>Course Title:</th>
<th>Multi- and many-core processors for multimedia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course is</td>
<td>modified ☑ new □</td>
</tr>
</tbody>
</table>
| Explain relation between workload and ECTS credits: | 6 ECTS  
26 hours lectures, 13 hours tutorial, 6 hours of other contact activities and 135 hours of individual work |
| Course Date: | (term and dates if already known):             |

## Lecturer:
- Lecturer’s name: Prof. Dr. Patricio Bulić, Associate Professor
- Office location: 
- Office hours: 
- Phone: +386 1 4768 361
- email address: patricio.bulic@fri.uni-lj.si

## Course Type
(e.g. seminar, lecture, lab sessions, etc.)
- Lecture

## Format
(e.g. once per week, block course, etc. – specify number of course sessions)
- block course

## Content Description:
The high number of parallel cores poses a great challenge for software design that must expose massive parallelism to benefit from the new hardware. We will describe the modern GPUs that are a highly parallel, highly multithreaded multiprocessor optimized for visual computing. The aim of this course is to teach practical multimedia algorithms design for processors with massively parallel computing resources.

- Introduction to multi- and many-core processors’ architecture.
### GPU System Architectures
- CUDA and OpenCL programming in C for GPU architecture.
- Programs and Kernels. Memory hierarchy.
- Parallelization of two- and three-dimensional imaging.
- Parallelization of computer-vision algorithms.
- Image and video categorization on massively parallel processors.
- Best practices in GPU-based image and video processing.
- GPU-based medical image computing techniques.
- Reading and discussing research papers.

### Assessment Modalities:

- examination

### Learning Outcomes:
(show how course contributes to objectives of the module)

This course is designed for students in all disciplines to learn the essence of these programming interfaces CUDA and OpenCL and how they should orchestrate the use of these interfaces to achieve application goals. After finishing the course, the students will be able to develop multimedia algorithms (image and video processing, medical imaging, etc.) for massively parallel processors.

### Teaching Methods:
Please state how the course will be taught.

Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)

- Lectures, assignments and tutorials

### Required/ recommended Literature
(include publication details)

<table>
<thead>
<tr>
<th>Required book(s)</th>
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<thead>
<tr>
<th>Recommended book(s)</th>
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<tbody>
<tr>
<td>van den Sande K.E.A., Gevers T., Snoek</td>
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</table>

<table>
<thead>
<tr>
<th>Journals or other material</th>
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<tbody>
<tr>
<td>1. van den Sande K.E.A., Gevers T., Snoek</td>
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<tr>
<th>Course Syllabus</th>
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<tbody>
<tr>
<td><strong>Course Title:</strong></td>
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<td><strong>Course is</strong></td>
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<tr>
<td><strong>Explain relation between workload and ECTS credits:</strong></td>
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<tr>
<td><strong>Course Date:</strong> (term and dates if already known):</td>
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<tr>
<td><strong>Lecturer:</strong></td>
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<tr>
<td><strong>Course Type</strong> (E.g. seminar, lecture, lab sessions, etc.)</td>
</tr>
<tr>
<td><strong>Format</strong> (e.g. once per week, block course, etc. – specify number of course sessions)</td>
</tr>
</tbody>
</table>
## Assessment Modalities:

Project work including a state of the art report

## Learning Outcomes:

At the end of this course students will be able to:

- Deeply understand the principle and recent advances in multimedia processing;
- Describe the computational principles underlying both current and emerging multimedia signal processing tasks;
- Discuss the main problems and approaches in the area of multimedia processing;
- Find a suitable solution for complex multimedia processing problem.

## Teaching Methods:

This course is taught using a combination of teaching methods including lectures, class discussions, working on projects and project presentations.

## Required/recommended Literature

<table>
<thead>
<tr>
<th>Required book(s)</th>
<th>Recommended book(s)</th>
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</thead>
</table>

## Journals or other material

Indexed journal and conference papers on multimedia, image processing, and signal processing
<table>
<thead>
<tr>
<th>Course Syllabus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title:</strong></td>
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<tr>
<td><strong>Course is</strong></td>
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<tr>
<td><strong>Explain relation between workload and ECTS credits:</strong></td>
</tr>
<tr>
<td><strong>Course Date:</strong> (term and dates if already known):</td>
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<tr>
<td><strong>Lecturer:</strong></td>
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<tr>
<td><strong>Course Type</strong> (e.g. seminar, lecture, lab sessions, etc.)</td>
</tr>
<tr>
<td><strong>Format</strong> (e.g. once per week, block course, etc. – specify number of course sessions)</td>
</tr>
</tbody>
</table>
### Assessment Modalities:
During course lectures every student has given presentation of idea and general structure of his/her seminar work. Before final written exam student is obligated to finish and present seminar work. On demand of a student oral exam will be done, instead of written one.

### Learning Outcomes:
(Show how course contributes to objectives of the module)
Upon completion of this course, the students will be familiar with fundamental principles of robotics, automation and computer integrated manufacturing. Furthermore, they will get deep knowledge of robotic vision in particular on image enhancement and image analysis and image based control.

### Teaching Methods:
Please state how the course will be taught. Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)
The course will be taught throughout lectures which will include: teaching about theoretical state of art in the topics, class discussions and illustrative laboratory exercises. Furthermore, team work will be promoted by students’ short presentation and discussions about seminar work of every student. All activities will be supported by the LMS (Learning Management System) at Faculty of Electrical Engineering.

<table>
<thead>
<tr>
<th>Required/recommended Literature</th>
<th>Required book(s)</th>
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<tr>
<th>Recommended book(s)</th>
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<table>
<thead>
<tr>
<th>Journals or other material</th>
</tr>
</thead>
</table>
| 1. International Journal of Computer Vision, Springer Netherlands  
2. IEEE Transaction on Robotics |
<table>
<thead>
<tr>
<th><strong>Course Title:</strong></th>
<th>Multimedia Information Retrieval and Management</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course is</strong></td>
<td>modified ✓ new □</td>
</tr>
<tr>
<td><strong>Explain relation between workload and ECTS credits:</strong></td>
<td>6 ECTS 45 hours of contact hours and 135 hours of students’ individual work</td>
</tr>
<tr>
<td><strong>Course Date:</strong></td>
<td>-</td>
</tr>
<tr>
<td><strong>Lecturer:</strong></td>
<td>Lecturer’s name: Dr. Vladimir Risojević, Assistant Professor</td>
</tr>
<tr>
<td></td>
<td>Office location: University of Banja Luka, Faculty of Electrical Engineering, Patre 5, 78000 Banja Luka, BiH</td>
</tr>
<tr>
<td></td>
<td>Office hours: Working day 11:00 – 15:00 or on appointment</td>
</tr>
<tr>
<td></td>
<td>Phone: +387 51 221 847</td>
</tr>
<tr>
<td></td>
<td>email address: <a href="mailto:vlado@etfbl.net">vlado@etfbl.net</a></td>
</tr>
<tr>
<td><strong>Course Type</strong></td>
<td>lecture, seminar</td>
</tr>
<tr>
<td><strong>Format</strong></td>
<td>once per week</td>
</tr>
<tr>
<td><strong>Content Description:</strong></td>
<td>Overview of the multimedia information retrieval and management approaches. Content-based retrieval and classification. Feature extraction from multimedia content: text, audio, images, and video. Multimodal retrieval. Application of machine learning techniques in multimedia information retrieval. Evaluation in multimedia information retrieval.</td>
</tr>
<tr>
<td><strong>Assessment Modalities:</strong></td>
<td>Project work including a state of the art report</td>
</tr>
</tbody>
</table>
### Learning Outcomes:
(show how course contributes to objectives of the module)

The students will have an advanced knowledge of multimedia information retrieval techniques, as well as their application areas. They will understand advantages and drawbacks of various approaches and how they fit into the global framework for multimedia information retrieval and management. Furthermore, they will be able to apply and improve multimedia information retrieval techniques in different application scenarios.

### Teaching Methods:
Please state how the course will be taught.

Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)

This course is taught using a combination of teaching methods including lectures, class discussions, working on projects and project presentations.

### Required/recommended Literature
(include publication details)

<table>
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<th>Required book(s)</th>
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<th>Recommended book(s)</th>
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<thead>
<tr>
<th>Journals or other material</th>
<th>Journals or other material</th>
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</table>

Journals:
IEEE Transactions on Multimedia,
IEEE Transactions on Pattern Analysis and Machine Intelligence,
IEEE Transactions on Image Processing
International Journal on Computer Vision
<table>
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<tr>
<th>Conference proceedings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE Computer Vision and Pattern Recognition</td>
</tr>
<tr>
<td>IEEE International Conference on Computer Vision</td>
</tr>
<tr>
<td>European Conference on Computer Vision</td>
</tr>
<tr>
<td>IEEE International Conference on Image Processing</td>
</tr>
<tr>
<td>Course Title:</td>
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<tr>
<td>Course is</td>
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<tr>
<td>Explain relation between workload and ECTS credits:</td>
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<tr>
<td>Course Date: (term and dates if already known):</td>
</tr>
<tr>
<td>Lecturer:</td>
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<tr>
<td>Office location:</td>
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<td>Office hours:</td>
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<td>Phone:</td>
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<tr>
<td>email address:</td>
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<tr>
<td>Course Type (e.g. seminar, lecture, lab sessions, etc.)</td>
</tr>
<tr>
<td>Format (e.g. once per week, block course, etc. – specify number of course sessions)</td>
</tr>
<tr>
<td>Content Description:</td>
</tr>
</tbody>
</table>
concentrate on this learning approach during the lecture and discuss both the theoretical background (dynamic programming, Markov decision processes) and applications. In these lecture we will also cover genetic algorithms, which is another interesting approach to machine learning of successful policies. Here the computer simulates evolution by randomly mutating and crossing-over different promising strategies.

<table>
<thead>
<tr>
<th>Assessment Modalities:</th>
<th>Written examination and presentation of seminar work.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning Outcomes:</td>
<td>Students will deeply learn of machine learning methods for artificial agents, and to apply such methods for the solution of problems in various fields.</td>
</tr>
<tr>
<td>Teaching Methods:</td>
<td>This course will be taught using a variety of teaching methods including lectures, class discussions, team work, project creation.</td>
</tr>
<tr>
<td>Required/ recommended Literature (include publication details)</td>
<td>Required book(s): R. Sutton and A. Barto: Reinforcement Learning - An Introduction, MIT Press</td>
</tr>
<tr>
<td></td>
<td>Recommended book(s): Bertsekis/Tsitsiklis: Neuro-Dynamic Programming, Athena Scientific</td>
</tr>
<tr>
<td></td>
<td>Journals or other material</td>
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<tr>
<td>Course Syllabus</td>
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</tr>
<tr>
<td><strong>Course Title:</strong></td>
<td>Internet of Things Technologies and Applications</td>
</tr>
<tr>
<td><strong>Course is</strong></td>
<td>modified [ ] new [ √ ]</td>
</tr>
<tr>
<td><strong>Explain relation between workload and ECTS credits:</strong></td>
<td>6 ECTS 45 hours of contact hours and 135 hours of students’ individual work</td>
</tr>
<tr>
<td><strong>Course Date:</strong></td>
<td>(term and dates if already known):</td>
</tr>
<tr>
<td><strong>Lecturer:</strong></td>
<td>Prof. Dr. Gordana Gardašević, Associate Professor</td>
</tr>
<tr>
<td>Lecturer’s name:</td>
<td></td>
</tr>
<tr>
<td>Office location:</td>
<td>University of Banja Luka, Faculty of Electrical Engineering, Patre 5, 78000 Banja Luka, BiH</td>
</tr>
<tr>
<td>Office hours:</td>
<td>on appointment</td>
</tr>
<tr>
<td>Phone:</td>
<td>+387 51 221 877</td>
</tr>
<tr>
<td>email address:</td>
<td><a href="mailto:gordana.gardasevic@etfbl.net">gordana.gardasevic@etfbl.net</a></td>
</tr>
<tr>
<td><strong>Course Type</strong></td>
<td>Lectures, projects, lab sessions</td>
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<tr>
<td>(e.g. seminar, lecture, lab sessions, etc.)</td>
<td></td>
</tr>
<tr>
<td><strong>Format</strong></td>
<td>Once per week</td>
</tr>
<tr>
<td>(e.g. once per week, block course, etc. – specify number of course sessions)</td>
<td></td>
</tr>
<tr>
<td>Assessment Modalities:</td>
<td>Written/oral examination and presentation of project work</td>
</tr>
<tr>
<td>------------------------</td>
<td>---------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Learning Outcomes:</strong></td>
<td>Upon completion of this course, students will be able to:</td>
</tr>
<tr>
<td>(show how course contributes to objectives of the module)</td>
<td>- comprehensively understand the IoT standards, architectures and protocols</td>
</tr>
<tr>
<td></td>
<td>- understand actual hardware platforms, test-beds and simulators</td>
</tr>
<tr>
<td></td>
<td>- apply up-to-date technologies to implement IoT solutions</td>
</tr>
<tr>
<td></td>
<td>- develop and build IoT design projects and applications</td>
</tr>
<tr>
<td></td>
<td>- link IoT networks to cloud computing networks</td>
</tr>
<tr>
<td><strong>Teaching Methods:</strong></td>
<td>The course is taught using lectures, class discussions, supervised team work, project creation.</td>
</tr>
<tr>
<td>Please state how the course will be taught.</td>
<td>Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)</td>
</tr>
<tr>
<td><strong>Required/recommended Literature</strong> (include publication details)</td>
<td>Required book(s)</td>
</tr>
<tr>
<td></td>
<td>Recommended book(s)</td>
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<tr>
<td><strong>Course Syllabus</strong></td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Course Title:</strong> Advanced Topics in Internet Technologies</td>
<td></td>
</tr>
<tr>
<td><strong>Course is</strong> modified √ new □</td>
<td></td>
</tr>
<tr>
<td><strong>Explain relation between workload and ECTS credits:</strong> 6 ECST 30 lecture hours, 15 other contact hours and 135 hours of individual work</td>
<td></td>
</tr>
<tr>
<td><strong>Course Date:</strong> (term and dates if already known): -</td>
<td></td>
</tr>
<tr>
<td><strong>Lecturer:</strong></td>
<td></td>
</tr>
<tr>
<td>Lecturer’s name: Dr. Pavle Vuletić, Assistant Professor</td>
<td></td>
</tr>
<tr>
<td>Office location: University of Belgrade, Faculty of Electrical Engineering, Bulevar kralja Aleksandra 73, 11120 Beograd, Srbija</td>
<td></td>
</tr>
<tr>
<td>Office hours: Working day 09:00 – 17:00 or on appointment</td>
<td></td>
</tr>
<tr>
<td>Phone: +381 63 237 359</td>
<td></td>
</tr>
<tr>
<td>email address: <a href="mailto:pavle.vuletic@etf.bg.ac.rs">pavle.vuletic@etf.bg.ac.rs</a></td>
<td></td>
</tr>
<tr>
<td><strong>Course Type</strong> (e.g. seminar, lecture, lab sessions, etc.) Lecture+seminar+lab sessions.</td>
<td></td>
</tr>
<tr>
<td><strong>Format</strong> (e.g. once per week, block course, etc. – specify number of course sessions) Lecture, block course, 4 sessions</td>
<td></td>
</tr>
<tr>
<td><strong>Content Description:</strong> The course will cover selected topics in computer networks and Internet such as:</td>
<td></td>
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<tr>
<td>- BGP routing protocol and Internet architecture</td>
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<tr>
<td>- Virtual Private Networks</td>
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</tr>
<tr>
<td>- Quality of Service QoS</td>
<td></td>
</tr>
<tr>
<td>- Multicast</td>
<td></td>
</tr>
<tr>
<td>- Network management</td>
<td></td>
</tr>
<tr>
<td>Assessment Modalities:</td>
<td>Assignments (40%), project (60%).</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Learning Outcomes:</td>
<td>Deep knowledge in internet technologies.</td>
</tr>
<tr>
<td>(show how course contributes to objectives of the module)</td>
<td></td>
</tr>
<tr>
<td>Teaching Methods:</td>
<td>This course will be taught using a variety of teaching methods including lectures, class discussions, team work and final project creation.</td>
</tr>
<tr>
<td>Please state how the course will be taught.</td>
<td></td>
</tr>
<tr>
<td>Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Required recommended Literature (include publication details)</th>
<th></th>
</tr>
</thead>
</table>
doi:10.1145/1186778.1186782

doi:10.1002/nem.1841
## Course Syllabus

<table>
<thead>
<tr>
<th>Course Title:</th>
<th>Cryptography and Computer Systems Security</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course is</td>
<td>modified □ new □</td>
</tr>
<tr>
<td>Explain relation between workload and ECTS credits:</td>
<td>6 ECST 45 hours of contact hours and 135 hours of students’ individual work</td>
</tr>
<tr>
<td>Course Date: (term and dates if already known):</td>
<td>-</td>
</tr>
<tr>
<td>Lecturer:</td>
<td>Lecture + seminar + lab sessions</td>
</tr>
<tr>
<td>Lecturer’s name:</td>
<td>Prof. Dr. Zoran Djurić, Assistant Professor</td>
</tr>
<tr>
<td>Office location:</td>
<td>Patre 5, Banja Luka</td>
</tr>
<tr>
<td>Office hours:</td>
<td>Working day 09:00 – 13:00 or on appointment</td>
</tr>
<tr>
<td>Phone:</td>
<td>+387 51 221 820</td>
</tr>
<tr>
<td>email address:</td>
<td><a href="mailto:zoran@spinter.net">zoran@spinter.net</a></td>
</tr>
<tr>
<td>Format (e.g. once per week, block course, etc. – specify number of course sessions)</td>
<td>- once per week</td>
</tr>
<tr>
<td>Content Description:</td>
<td>This course will take participants through the most important issues in cryptography and computer systems security, including general security concepts, potential risks and attacks identification, software exploitation, infrastructure security, communication activity monitoring, OS and application and network devices hardening, cryptographic algorithms, cryptographic systems, Public Key Infrastructure, cryptographic standards, operational/organizational security, security management and computer forensics, Legal issues, Economic issues and Ethics.</td>
</tr>
</tbody>
</table>
| Assessment Modalities: | - Solving homework problems - 40%  
- Project - 40%  
- Final Exam – 20% |
| Learning Outcomes: (show how course contributes to objectives of the module) | After completing this course, participants will:  
- Understand potential threats, vulnerabilities and attacks  
- Know how to adopt various security measures,  
- Have hands-on experience in security-related tools and technologies  
- Be able to analyze, design, and build secure systems of moderate complexity. |
| Teaching Methods: Please state how the course will be taught. Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room) | - Lectures  
- Class discussions  
- Labs  
- Team work  
- Project creation  
- Email and website discussions |
| Required/ recommended Literature (include publication details) | Required book(s)  
- Simson Garfinkel, Gene Spafford: Practical Unix and Internet Security, O'Reilly, 1996 |
| | Recommended book(s)  
| | Journals or other material  
- |
<table>
<thead>
<tr>
<th><strong>Course Title:</strong></th>
<th>Speech Processing and Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course is</strong></td>
<td>modified  □  new  □</td>
</tr>
</tbody>
</table>
| **Explain relation between workload and ECTS credits:** | 6 ECTS  
45 hours of contact hours and 135 hours of students’ individual work |
<p>| <strong>Course Date:</strong> | (term and dates if already known): |
| <strong>Lecturer:</strong> |  |
| Lecturer’s name: | Prof. Dr. Vlado Delić, Full Professor |
| Office location: |  |
| Office hours: |  |
| Phone: |  |
| email address: | <a href="mailto:vlado.delic@ktios.net">vlado.delic@ktios.net</a> |
| <strong>Course Type</strong> | (e.g. seminar, lecture, lab sessions, etc.) | seminar, lecture, lab sessions |
| <strong>Format</strong> | (e.g. once per week, block course, etc. – specify number of course sessions) | once per week |
| <strong>Content Description:</strong> | Discrete model for speech signal generation. Speech perception. Basic parameters of speech signal (fundamental frequencies, formant frequencies, predictor’s coefficients, etc.). Speech signal coding and transformation, modern techniques. Comparison of techniques for speech signal coding. Perspective of men-machine interaction. |</p>
<table>
<thead>
<tr>
<th>Assessment Modalities:</th>
<th>Project (50%), final exam (50%).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learning Outcomes:</strong></td>
<td>Deep knowledge in speech processing and transmission.</td>
</tr>
<tr>
<td>(show how course contributes to objectives of the module)</td>
<td></td>
</tr>
<tr>
<td><strong>Teaching Methods:</strong></td>
<td>Lectures and presentation.</td>
</tr>
<tr>
<td>Please state how the course will be taught.</td>
<td></td>
</tr>
<tr>
<td>Example: This course is taught using a variety of teaching methods including lectures, class discussions, team work, project creation, and electronic discussion (email and website chat room)</td>
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<td><strong>Required/recommended Literature</strong> (include publication details)</td>
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