# PROGRAM DESCRIPTION

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1. PROGRAM DESCRIPTION

1.1. Introduction

Information technology is a dynamic discipline that concentrates on the use of computing in business, education, government, and other organizations. The scope of the discipline includes the development of systems based on computer and information technology and the application of those systems to improve enterprise operations. The work of information technology professionals is essential for effective operations in today’s knowledge-based society.

1.2. Mission

The mission of the Department of Information Technology is to educate the students to gain an understanding of the fundamentals of science and engineering so that they can develop solutions to Information Technology problems and enhance their skills on computer science, computer architecture, design and analysis of algorithms, software engineering, communication and research skills. It is aimed to especially emphasize teamwork, independent and innovative thinking and leadership qualities.

1.3. Our Merits and Principles

- Excellence in teaching and research
- Loyalty to ethical issues
- Professional and dedicated working habits
- Alert to technological changes

1.4. Aims of the Programme

Information Technology Program aims to:
- Train the students to have theoretical background in basic sciences and engineering and to be equipped with necessary technical skills,
- Develop students’ competency in reading, writing and oral communication,
- Provide practical experience which will enable students to utilize and enhance their engineering knowledge,
- Promote students' self-discipline and self-assurance and the ability to learn on their own,
- Encourage team work, collaboration and development of interpersonal skills,
- Motivate the students towards contributing to the progress of science and technology,
- Teach the importance of ethical behaviour in social and professional life,
- Produce graduates for the engineering and the business communities who are observant, inquisitive and open to new technologies for developing better solutions,
- Produce graduates for the engineering and business communities with integrity, determination, judgment, motivation, ability and education to assume a leadership role to meet the demanding challenges of the society.
- To facilitate the provision of a quality learning experience for each student that fosters engagement with their programme of study and promotes independent study and life-long learning;
- To maintain a high quality, comprehensive and coherent computing focussed curriculum informed by research, scholarly activity and practice which enhances each participant’s career prospects;
- To develop professionals with a sound understanding of computing and a critical awareness of current issues, who are able to adopt appropriate research strategies, and are informed of wider contextual issues;
- To encourage the creative and appropriate application of technology to promote innovation, enterprise and employability;
- To promote ethical awareness and professionalism supported by a strong appreciation of industry focussed skills and practice.

1.5. Academic Program

The Information Technology program is based on three-year Bachelor Degree. The first year of the program is dedicated to the study of basic sciences and mathematics which provide the student with engineering fundamentals. The second and third year are mainly composed of basic engineering courses besides fundamental courses of Information Technology. Summer training at the end of the second and third year and the courses at the last year aim to provide students perspective in Information Technology. The Curriculum of the program includes elective courses, which give an opportunity to students to improve their professional skills according to their interests. Some of them are nontechnical and free elective courses, the remaining are technical electives. The requirements for a Diploma in Information Technology include the completion of minimum of 180 ECTS credits of formal course work and 30 days of approved practical training. The students who completed the bachelor degree level can continue to attend masters’ level on their demand and if they meet the minimum GPA of bachelor level conditions. The academic program of Information Technology department is practical, competency-based, and designed to prepare students for entry-level positions as information technology professionals. The topics covered in IT course work include
  - the development of Internet business sites and electronic commerce;
  - the role of information systems in business and government;
  - fundamentals of computer programming, data analysis, and networking;
  - database concepts, applications, and design;
  - information systems analysis, design, and implementation;
  - information security, information assurance, and network security.

1.6. Internships

Internships for academic credit add a significant workplace experience to a student’s education. Students gain valuable “on the job” work experience related to a chosen focus in information systems applications. In addition, internships permit students to interact with professionals in the fields of work in which they may one day have careers.

1.7. Learning and Teaching

Learning and teaching methods provide high quality learning opportunities that enable students to demonstrate achievement of the learning outcomes of the course and those of the modules which constitute their chosen route of study.

The course aims to foster the development of independent study skills and autonomy of learning and encourage a commitment to lifelong learning and continuous professional development. Teaching and learning methods increasingly promote the capacity for students to assume responsibility for their own learning and development. Progressive use of project learning, integrated assessment and product/problem based learning allow students to take on greater self-direction of their learning. Emphasis is often placed on group and team working throughout the three years of study and, in particular, there is a final year project, which students may undertake as a member of a team if they desire.

The course employs a wide range of learning opportunities and teaching methods, informed by curriculum review, pedagogic research and continuous staff development. Particular methods for each module or cohort are identified prior to delivery through the annual planning process. Innovative approaches to teaching,
learning and assessment are encouraged. The course seeks to expand the application of technology in the delivery of teaching and learning support wherever appropriate.

Scheduled sessions will include the use of lectures, seminars, tutorials and practical laboratory sessions. Advantage will be taken of both technology and supportive activities to ensure that effective learning takes place. These activities will include the use of simulations, role play, case studies, projects, practical work, work based learning, workshops, peer tutoring, peer group interaction, self-managed teams and learner managed learning.

1.7.1. Teaching/learning methods and strategies

Lectures/classes: offer information, literature review and illustrative application and present and explore core ideas in the subject. A student will apply intellectual skills to prepare solutions to examples sheet questions which will be discussed in a small class

Practical sessions: computational methods are taught as a series of computer-based practicals with short introductory lectures on theory. This enables a student to understand issues in application of computational methods to simulated and real problems and also develop computing skills relevant to the rest of the course including the research project. Practicals, computer-based and experimental lab based, provide an opportunity for a student to consolidate the theory they have learned about in lectures and apply it to problems.

Group project: provides an opportunity to study a real IT problem in depth, practice analytic and problem-solving skills, and work in a team.

Individual project: involves a literature review, problem specification and experiments/analysis written up in a report. This enables a student to practice the application of techniques they have learned about to an IT problem in some depth as well as put into practice general research skills.

Expert (guest) lectures and seminars: provide a student with the opportunity to hear internal speakers and external speakers from industry. This enables a student to gain appreciation of some applications, needs and roles of computer engineers as well as career opportunities.

1.8. Assessment Protocols

The purpose of outcomes-based learning assessment is to improve the quality of learning and teaching in Information Technology department. The fundamental principles are:

- Student learning is the central focus of the department's efforts.
- Each student is unique and will express learning in a unique way.
- Students must be able to apply their learning beyond the classroom.
- Students should become effective, independent, lifelong learners as a result of their educational experience.

Assessment of the IT Learning Outcomes (ITLOs) begins with the normal assessment process in the major courses that are taken by students. Each course defines course outcomes and relates the course outcomes to the ITLOs. Students also prepare portfolios that reflect their achievements and capabilities, and the evaluation of the portfolios by a faculty committee represents the final assessment of a student's achievement in the ITLOs.

1.8.1. Assessment

Assessment of intellectual skills is done by:

- Written examinations
● Written essay assignments
● Assessment of practical work
● Group project report and team presentation
● Individual project report and short presentation/viva

1.8.2. Grading

The final success of a student after all envisioned forms of testing is evaluated and graded through the system of comparison ECTS with the scale of grading, as follows:

a) 10 (A) – outstanding performance without errors or with minor errors, carries 95-100 points
b) 9 (B) – above average, with few errors, carries 85-94 points
c) 8 (C) – average, with notable errors, carries 75-84 points
d) 7 (D) – generally good, but with significant shortcomings, carries 65-74 points
e) 6 (E) – meets minimum criteria, carries 55-64 points;
f) 5 (F, FX) – performance does not meet minimum criteria, less than 55 points.

1.9. Intended Learning Outcomes

Learning Outcomes for Information Technology department are as follows:

**Critical Thinking and Quantitative Reasoning in IT:** IT department graduates will be able to use critical thinking and quantitative processes to identify, analyze, and solve problems and evaluate solutions in an IT context.

**Information Technology Application:** IT department graduates will be able to select existing and cutting-edge IT tools and procedures to develop modules and systems.

**Information Technology Management:** IT department graduates will be able to assess and determine information resource requirements to develop solutions suitable for IT and business managers operating in a multinational and multicultural environment.

**Information Technology Professional Practice:** IT department graduates will be able to work effectively in individual and group situations, understand how groups interact, assume a leadership role when required, and understand the fundamentals of professional and ethical conduct.

**Information Technology Systems Theory and Practice:** IT department graduates will be able to understand and communicate the fundamentals of systems theory in the development of appropriate systems that function in a global environment.

On successful completion, IT department students will be able to:

● Demonstrate knowledge and critical understanding of the well-established principles of computing, and of the way in which those principles have developed as technology has progressed
● Demonstrate ability to apply underlying concepts and principles outside the context in which they were first studied, including, where appropriate, the application of those principles in an employment context
● Demonstrate knowledge of all of the main development methods relevant to the field of computing, and ability to evaluate critically the appropriateness of different approaches to solving problems in the field of study
● Demonstrate an understanding of the limits of their knowledge, and how it influences analyses and interpretations based on that knowledge
● Demonstrate ability to apply a range of established techniques to initiate and undertake critical analysis of information, and to propose solutions to problems from that analysis
● Demonstrate ability to undertake intermediate level systems development work using industry recognised tools, technologies and techniques.
1.10. **Transferable skills**

By the end of the course a student will have developed a range of transferable skills including skills in:

- Managing their own learning and conducting independent thinking and study
- Problem specification and modelling
- Applying mathematical and computational methods to solve (engineering) problems
- Use of general information technology
- Managing a research project, including planning and time management
- Conducting an engineering-based research-based work, from hypothesis to report writing
- Working in a multi-disciplinary team
- Critical analysis

1.11. **Skills and other attributes**

- can effectively communicate information, arguments and analysis in a variety of forms to specialist and non-specialist audiences, and deploy key techniques of the discipline effectively
- can undertake further training, develop existing skills and acquire new competences that will enable them to assume significant responsibility within organisations
- have the qualities and transferable skills necessary for employment requiring the exercise of personal responsibility and decision-making

1.12. **Methods for Evaluating and Improving the Quality and Standards of Teaching and Learning**

- Student Focus groups and the annual student survey
- Class room observation of Lecturers
- Advanced Professional Diploma in Teaching and Learning in Higher Education
- Membership of the Higher Education Academy
- External Examiners reports
- Accreditation Visits
- Curriculum Area Review
- Course Committees
- Annual and periodic review

1.13. **Indicators of Quality and Standards**

- Student feedback
- Retention and success rates for each level for each course
- Student Module Evaluations
- Annual Student Questionnaires
- First Destination Statistics
- Professional accreditation
- External Examiner reports

1.14. **Criteria for Admission**

The admissions policy for overall Scheme, in which the IT course operates, is to admit any applicant who is capable of benefiting from and successfully completing their chosen course. Applicants meeting the scheme
admissions profile or producing alternate evidence for Accreditation of Prior Learning / Accreditation of Prior Experiential Learning at least equivalent to the scheme admissions profile satisfy this judgement in practice. Where selection criteria are devised they will be tuned to satisfy the widening participation agenda and equal opportunity policy of the University. Admissions profiles will be reviewed annually as will selection criteria and will provide a fair and objective basis for selection to oversubscribed courses. Admission with advanced standing will follow University Procedures. The Scheme encourages non-standard and mature applicants, and applicants with advanced standing. These are considered on an individual basis.

Students whose first language is not English, with certificated qualifications, professional qualifications and or appropriate work experiences that are equivalent to those detailed above will be considered and encouraged to apply. In addition to these, you will also have to demonstrate that your standard of English is at IELTS, TOEFL or tests.

For all applicants, we will be looking for evidence of personal skills and qualities through a personal statement and references. Such skills and qualities include communication skills; literacy; numeracy; IT knowledge; study skills; subject and motivation; work experience and community involvement.
# CURRICULUM OF DEPARTMENT OF INFORMATION TECHNOLOGY

1. **Semester**

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¹ BOS 101 Bosnian/Croatian/Serbian Language I / TDE 101 Turkish Language I / GRM 101 German Language I
² BOS 102 Bosnian/Croatian/Serbian Language II / TDE 102 Turkish Language II / GRM 102 German Language II
### University Level Elective Courses

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<td>CEN 354</td>
<td>Introduction to Data Mining</td>
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<td>CEN 355</td>
<td>Special Topics in Database Systems</td>
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<tr>
<td>CEN 357</td>
<td>Strategic Information Systems</td>
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<tr>
<td>CEN 358</td>
<td>Introduction to Computer Vision</td>
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<tr>
<td>CEN 359</td>
<td>Introduction to Machine Learning</td>
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<tr>
<td>CEN 363</td>
<td>Introduction to Network Programming</td>
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<tr>
<td>CEN 382</td>
<td>Microprocessors and Microcomputing</td>
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<td>CEN 383</td>
<td>Signal Processing for Computer Engineering</td>
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<tr>
<td>CEN 384</td>
<td>Computer Architecture</td>
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<tr>
<td>CEN 385</td>
<td>Introduction to Cryptography</td>
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<tr>
<td>CEN 390</td>
<td>Introduction to Artificial Intelligence</td>
<td>3</td>
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<tr>
<td>CEN 391</td>
<td>Introduction to Neural Networks</td>
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<td>CEN 393</td>
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<td>CEN 394</td>
<td>Introduction to Pattern Recognition</td>
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<tr>
<td>CEN 396</td>
<td>Digital Data Communication</td>
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Course Code: CEN 101  
Course Name: COMPUTER ENGINEERING ORIENTATION  
Level: Undergraduate  
Year: 1  
Semester: 1  
ECTS Credits: 5  
Status: Compulsory  
Hours/Week: 3+0  
Total Hours: 45+0

**Course Description**  
Computer Engineering Orientation is a science which deals with providing counselling about the department and computer engineering profession. The focus of this course is on computer applications. The course stresses the ways in which computers can help you solve problems efficiently and effectively. The course provides a broad introduction to hardware, software, and mathematical aspects of computers. Topics include: Hardware and software components of a computer system. Basic computer usage: Basics of operating systems, file operations, internet and office applications.

**Course Objectives**  
Objective of this course is to provide necessary information about computer engineering and the computer engineering profession. This includes hardware and software components of a computer system, basic computer usage, basics of operating systems, file operations, internet and office applications.

**Course Content**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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<table>
<thead>
<tr>
<th>Activity</th>
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<th>Duration</th>
<th>Workload</th>
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<tbody>
<tr>
<td>Midterm Exam</td>
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<tr>
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<tr>
<td>Storage and Multimedia (1)</td>
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<tr>
<td>Project presentation</td>
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</table>

**Teaching Methods Description**  
- Interactive lectures and communications with students
- Discussions and group works
- Presentations

**Assessment Methods Description (%)**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz</td>
<td>10 %</td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Lab/Practical Exam</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homework</td>
<td>10 %</td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Term Paper</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project</td>
<td>20 %</td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Attendance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>20 %</td>
<td></td>
<td>0 %</td>
</tr>
<tr>
<td>Class Deliverables</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentation</td>
<td>0 %</td>
<td></td>
<td>40 %</td>
</tr>
<tr>
<td>Final Exam</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total Workload**  
119

**ECTS Credit (Total Workload / 25)**  
5

**Learning Outcomes**

After completion of this course, students should be able to:
1. Demonstrate knowledge of fundamental aspects of the computer hardware and software.
2. Demonstrate technical competence by identifying, formulating, analyzing and solving engineering problems using appropriate engineering tools.
3. Apply core computer engineering and informatics technical knowledge.
4. Employ standard experimental techniques to generate and analyze data as well as use state-of-the-art hardware and software to solve computer engineering problems.
5. Demonstrate basic knowledge of operating systems and computer networking.

**Prerequisite Course(s)**

- 

**Language of Instruction**  
English

**Mandatory Literature**

- Computer Tools for an Information Age, by H.L. Capron and J.A. Johnson

**Recommended Literature**

**Course Code:** CEN 111  
**Course Name:** PROGRAMMING I  
**Level:** Undergraduate  
**Year:** 1  
**Semester:** I  
**ECTS Credits:** 6

<table>
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<th>Status</th>
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<tr>
<td>Hours/Week</td>
<td>3+2</td>
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<tr>
<td>Total Hours</td>
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</tbody>
</table>

**Course Description**
This course is designed to be an introduction to the fundamentals of programming. Students will design, write and debug computer programs. No knowledge of programming is assumed.

**Course Objectives**
Objectives of this course are to: introduce students to intermediate concept of programming; introduce students to basic algorithm design principles; substantially strengthen students' programming skills by requiring them to constantly program large number of small but challenging problems; encourage strive for excellence by introducing them to a competitive environment where part of their performance will be based on performance of their peers.

**Course Content**
- Introduction to the Course
- Software Development Life Cycle
- Character Strings and Formatted I/O (1)
- Character Strings and Formatted I/O (2)
- Operators, Expressions and Statements
- Selections
- If-Else (1)
- Midterm Exam
- If – Else (2)
- Loops (1)
- Loops (2)
- Functions (1)
- Functions (2)
- Arrays (1)
- Arrays (2)

**Teaching Methods Description**
- Interactive lectures and communication with students
- Practical Sessions

**Assessment Methods Description (%)**

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Quiz</th>
<th>Homework</th>
<th>Assignment</th>
<th>Midterm Exam</th>
<th>Presentation</th>
<th>Lab/Practical Exam</th>
<th>Term Paper</th>
<th>Attendance</th>
<th>Class Deliverables</th>
<th>Final Exam</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0 %</td>
<td>10 %</td>
<td>15 %</td>
<td>25 %</td>
<td>0 %</td>
<td>0 %</td>
<td>0 %</td>
<td>0 %</td>
<td>10 %</td>
<td>25 %</td>
<td>100 %</td>
</tr>
</tbody>
</table>

**Learning Outcomes**
After completion of this course, students should be able to:
1. Define basic terminology used in computer programming
2. Establish knowledge and understanding of intermediate C/C++ programming concepts
3. Analyze, design, code, compile and debug programs in C/C++ language.
4. Develop programs involving decision structures, loops and functions.
5. Use different data types in a computer program.

**Prerequisite Course(s)**
- 

**Language of Instruction**
English

**Mandatory Literature**

**Recommended Literature**

<table>
<thead>
<tr>
<th>ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activities</td>
</tr>
<tr>
<td>Lecture (15 weeks x Lecture hours per week)</td>
</tr>
<tr>
<td>Laboratory / Practice (15 weeks x Laboratory / Practice hours per week)</td>
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<td>Midterm Examination (1 week)</td>
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<td>Final Examination (1 week)</td>
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<tr>
<td>Preparation for Midterm Examination</td>
</tr>
<tr>
<td>Preparation for Final Examination</td>
</tr>
<tr>
<td>Assignment / Homework / Project</td>
</tr>
<tr>
<td>Seminar / Presentation</td>
</tr>
</tbody>
</table>

| Total Workload | 155 |
| ECTS Credit (Total Workload / 25) | 6 |
### Course Code: ELT 117  
### Course Name: ADVANCED READING AND VOCABULARY I

<table>
<thead>
<tr>
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<th>Year: I</th>
<th>Semester: I</th>
<th>ECTS Credits: 5</th>
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<tr>
<td>Status: Compulsory</td>
<td>Hours/Week: 2+2</td>
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#### Course Description
ELT 117 aims to help improve your ability to read, write and think. The course targets and strengthens literacy skills which are important for academic success, equipping you with the ability to read and write more effectively and to navigate the university environment with greater confidence. The course also focuses on transferable literacy skills that will assist you in workplace, digital and professional communications. Readings include academic publications, online journalism, blogs, multimedia texts, literary texts and visual texts. Techniques for taking notes and writing essays and paragraphs are a key focus of the course.

#### Course Objectives
Objectives of this course are to: increase students’ confidence and comfort with the English language; increase students’ vocabulary development and comprehension; enable students to eventually comfortably express their ideas in English; strengthen students’ English capacity so that they successfully listen and comprehend and memorize ideas that have been presented to them.

#### Course Content
- Introduction to Advanced Reading and Writing
- Grammar through relevant texts
- Grammar through relevant articles/journals/current relevant literature
- Vocabulary lessons and how to improve relevant word repertoire
- Vocabulary in the field of Information Technology (1)
- Vocabulary in the field of Information Technology (2)
- Speaking – group discussion and presentations of discussed topics
- Midterm Exam
- Speaking – one on one discussions and presentations of discussed topics
- Listening and learning (Lecturer followed by discussion)
- Engage in pre-writing activities
- Write clear, effective sentences and paragraphs
- Utilize critical thinking skills through discussion of read paragraph
- Summarize and paraphrase specific reading sections
- Preparation for Final Exam

#### Teaching Methods Description
- Interactive lectures and communication with students
- Discussions and group work
- Student debates
- Practical Sessions

#### Assessment Methods Description (%)

<table>
<thead>
<tr>
<th></th>
<th>Quiz</th>
<th>Lab/Practical Exam</th>
<th>Homework</th>
<th>Term Paper</th>
<th>Project</th>
<th>Attendance</th>
<th>Midterm Exam</th>
<th>Class Deliverables</th>
<th>Presentation</th>
<th>Final Exam</th>
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<tbody>
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<td>40 %</td>
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</tbody>
</table>

#### Learning Outcomes
After completion of this course, students should be able to:
1. Examine the written and lectured material.
2. Use English language more readily and comfortably, regardless of imperfections.
3. Present information in oral, written or graphic forms in order to communicate effectively with peers and tutors.
4. Speak English language with more confidence.
5. Engage in pre-writing activities.

#### Prerequisite Course(s)
- 

#### Language of Instruction
- English

#### Mandatory Literature
- No mandatory literature required. Reading material will be handed out during the course of the course.

#### Recommended Literature
- New English File

#### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
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<tr>
<td>Lecture (15 weeks x Lecture hours per week)</td>
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<tr>
<td>Laboratory / Practice (15 weeks x Laboratory / Practice hours per week)</td>
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<td>30</td>
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<td>Midterm Examination (1 week)</td>
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<td>Seminar / Presentation</td>
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<td><strong>Total Workload</strong></td>
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| ECTS Credit (Total Workload / 25)                    |          |          | 5        |
Course Code: PHY 101  
Course Name: GENERAL PHYSICS I

Level: Undergraduate  
Year: 1  
Semester: 1  
ECTS Credits: 6

Status: Compulsory  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description
Introductory course emphasizing mechanics and thermodynamics.

Course Objectives
Objective of the course is to give understanding the basic concepts mechanics and thermodynamics relative to the practical use in engineering.

Course Content
- Measuring things
- Motion along a straight line, (3) Vectors, (4) Motion in 2D and 3D
- Force and motion–I
- Force and motion–II
- Kinetic Energy and Conservation of Energy
- Center of Mass and Linear Momentum
- Midterm Exam
- Rotation
- Gravitation
- Fluids
- Oscillations
- Waves
- Temperature, Heat, and the First Law of Thermodynamics
- Entropy and the Second Law of Thermodynamics

Teaching Methods
- Lectures
- Recitation
- Experiments
- Presentations

Assessment Methods
<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz</td>
<td>20 %</td>
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</tr>
<tr>
<td>Homework</td>
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<tr>
<td>Project</td>
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<tr>
<td>Midterm Exam</td>
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<tr>
<td>Presentation</td>
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<tr>
<td>Term Paper</td>
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<td>Attendance</td>
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<tr>
<td>Class Deliverables</td>
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<td>Final Exam</td>
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<tr>
<td>Total</td>
<td></td>
<td></td>
<td>100 %</td>
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</tbody>
</table>

Learning Outcomes
After completion of this course, students should be able to:
1. Define phenomena, concepts and terminology of mechanics and thermodynamics.
2. Gain experience in problem-solving in the field of mechanics and thermodynamics.
3. Develop capabilities to present a topic in the field of mechanics and thermodynamics.
4. Apply knowledge obtained to an engineering field.
5. Develop interpersonal and listening skills.

Prerequisite Course(s)
- 

Language of Instruction
English

Mandatory Literature

Recommended Literature
- D.C. Giancoli: Physics for scientist and engineers, Prentice Hall, New Jersey, 2000
- The other sources from program fields. It is possible to use all books and Collection of problems on university level.

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
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<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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<tr>
<td>Lecture (15 weeks x Lecture hours per week)</td>
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<tr>
<td>Midterm Examination (1 week)</td>
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<td>2</td>
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<tr>
<td>Final Examination (1 week)</td>
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<td>Assignment / Homework / Project</td>
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<tr>
<td>Seminar / Presentation</td>
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ECTS Credit (Total Workload / 25)
6
<table>
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<td>ECTS Credits: 6</td>
<td>Total Hours: 45+30</td>
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</table>

**Course Description**
Use of calculus is widespread in science, engineering, medicine, business, industry, and many other fields. Calculus also provides important tools in understanding functions and has led to the development of new areas of mathematics including real and complex analysis, topology, and non-Euclidean geometry.

**Course Objectives**
Objectives of this course are to: expand understanding of mathematical topics that may have been previously studied; introduce and explore topics that possibly have not been part of the student’s mathematical experience; develop an appreciation for the development of mathematical thought; show the application of mathematics in real life problems and analyzing the results.

**Course Content**
- Preliminaries: Functions and graphs
- Preliminaries: Inverse functions and trigonometric functions
- Limits and Continuity: Limits, limits involving infinity
- Limits and Continuity: Continuity and tangent lines
- Derivatives: Rate of change
- Derivatives: Derivative rules and properties
- Derivatives: Chain rule & implicit derivative.
- Midterm Exam
- Application of Derivatives: Extreme values, mean value theorem
- Application of Derivatives: Concavity and Curve Sketching
- Application of Derivatives: Indeterminate forms and L’Hospital rule
- Integration: Estimating with finite sums, Riemann sum, the definite integral
- Integration: The fundamental theorem of calculus
- Integrals and transcendental functions
- Improper Integrals

**Teaching Methods Description**
- Lectures
- Recitation
- Problem solving
- Exercises

**Assessment Methods Description (%)**
- Quiz: 25 %
- Lab/Practical Exam: 0 %
- Homework: 0 %
- Term Paper: 0 %
- Project: 0 %
- Attendance: 0 %
- Midterm Exam: 25 %
- Class Deliverables: 0 %
- Presentation: 0 %
- Final Exam: 50 %
- Total: 100 %

**Learning Outcomes**
On successful completion of the course, the students should be able to:
1. Recognize properties of functions and their inverses.
2. Recall and use properties of polynomials, rational, exponential, logarithmic, trigonometric and inverse trigonometric functions.
3. Sketch graphs, using function, its first derivative, and the second derivative.
4. Use algebra of limits, and l’Hôpital’s rule to determine limits of simple expressions.
5. Apply the procedures of differentiation accurately, including implicit and logarithmic differentiation.

**Prerequisite Course(s)**
- English

**Mandatory Literature**

**Recommended Literature**
- Calculus with Analytic Geometry, R.A. Silverman, Prentice Hall, 1985

### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture (15 weeks x Lecture hours per week)</td>
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<td>3</td>
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<tr>
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</tr>
<tr>
<td>Midterm Examination (1 week)</td>
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<td>1</td>
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**ECTS Credit (Total Workload / 25)**

6
**Course Code:** CEN 112  
**Course Name:** PROGRAMMING II  
**Level:** Undergraduate  
**Year:** I  
**Semester:** II  
**ECTS Credits:** 6

<table>
<thead>
<tr>
<th>Status</th>
<th>Hours/Week: 3+2</th>
<th>Total Hours: 45+30</th>
</tr>
</thead>
</table>

**Course Description**
The course fully covers the intermediate and advanced topics of programming in the "C/C++" programming. This course provides students with a comprehensive study of the C/C++ programming language. Classroom lectures stress the strengths of C/C++, which provide programmers with the means of writing efficient, maintainable, and portable code.

**Course Objectives**
Objectives of this course are to: introduce students to intermediate and advanced concept of programming; be able in principle to program in an imperative (or procedural) programming language; learn good working practices: self-motivation, good time management, making use of information sources, thinking and acting rationally, learning how to learn, and learning how to behave and get the best from the adult environment of lecture room, laboratory and community of academics; increase the ability to learn new programming languages; become effective problem solver.

**Course Content**
- Recursive Functions (1)
- Recursive Functions (2)
- Recursion vs Iteration
- Multi-Dimensional Arrays (1)
- Multi-Dimensional Arrays (2)
- Pointers (1)
- Pointers (2)
- Midterm Exam
- Structures (1)
- Structures (2)
- Structures (3)
- Other Data Forms
- File I/O (1)
- File I/O (2)
- Preparation for Final Exam

**Teaching Methods**
- Interactive lectures and communication with students
- Practical Sessions

**Assessment Methods**
<table>
<thead>
<tr>
<th>Description</th>
<th>Quiz</th>
<th>Lab/Practical Exam</th>
<th>Homework</th>
<th>Term Paper</th>
<th>Project</th>
<th>Attendance</th>
<th>Midterm Exam</th>
<th>Class Deliverables</th>
<th>Presentation</th>
<th>Final Exam</th>
<th>Total</th>
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<td>10 %</td>
<td>0 %</td>
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</tbody>
</table>

**Learning Outcomes**
After completion of this course, students should be able to:
1. Create algorithms to solve intermediate and advanced programming problems.
2. Analyze, design, implement, test and debug programs that using advanced topics.
3. Appreciate current research and developments in the area of programming languages.
4. Examine the dynamics of memory by the use of pointers.
5. Use different data structures and create/update basic data files.

**Prerequisite Course(s)**
Programming I

**Language of Instruction**
English

**Mandatory Literature**

**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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**ECTS Credit (Total Workload / 25)**

6
Course Code: MAN 105  Course Name: COMMUNICATION SKILLS
Level: Undergraduate  Year: I  Semester: II  ECTS Credits: 4
Status: Compulsory  Hours/Week: 2+2  Total Hours: 30+30

Course Description
Communication skills are an essential element every employee and manager must have as part of their standard tool set. In this course, through interactive lectures, self-assessments, role-playing activities and video simulations, students gain practical experience passed on a flexible, genuine and self-confident approach.

Course Objectives
This course is designed to help develop strong oral and written communication skills. The student will be given opportunities to practice writing and editing professional correspondence. Additionally, the student will compose and deliver oral presentations.

Course Content
- Introduction to Communication
- Non-verbal Communication
- Introduction to Critical Thinking
- Intercultural Communications
- Employment Communication
- Report Writing
- Preparation for Midterm Exam
- Midterm Exam
- Public Speaking
- Improving listening skills
- Analyzing and evaluating strength of arguments
- Using persuasive language
- Judging the credibility of references
- Oral Presentation
- Preparation for Final Exam

Teaching Methods
- Interactive lectures and communication with students
- Discussions, presentations and group work
- Lectures and videos
- Problem solving, critical thinking and case studies

Assessment Methods
<table>
<thead>
<tr>
<th>Description (%)</th>
<th>Quiz</th>
<th>Homework</th>
<th>Project</th>
<th>Midterm Exam</th>
<th>Presentation</th>
<th>Lab/Practical Exam</th>
<th>Term Paper</th>
<th>Attendance</th>
<th>Class Deliverables</th>
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<td>25 %</td>
<td>100 %</td>
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</tbody>
</table>

Learning Outcomes
After completion of this course, students should be able to:
1. Determine the appropriate situations in which to use the deductive approach to convey information.
2. Determine the appropriate situations in which to use the inductive approach to convey information.
3. Compose concise and effectively written material (letters, memos, e-mail, reports, newsletters, news releases, and business presentations) presented in accurately keyed format with correct grammar, usage, and rules of style.
4. Compose and present concise and effectively worded oral reports.
5. Work collaboratively in a team setting by sharing in collective decision-making, meeting deadlines, and presenting group progress in an oral report.

Prerequisite Course(s)
-

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT'S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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ECTS Credit (Total Workload / 25)

4
Course Code: PHY 102  
Course Name: GENERAL PHYSICS II

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<th>Year: I</th>
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<td>Total Hours: 45+30</td>
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**Course Description**
Introductory course emphasizing electromagnetism, optics, atomic, and nuclear physics.

**Course Objectives**
Objective of the course is to give understanding the basic concepts mechanics and thermodynamics relative to the practical use in engineering.

**Course Content**
- Coulomb’s Law, Electric Fields
- Gauss’ Law
- Electric Potential
- Capacitance
- Current and Resistance
- Circuits
- Magnetic fields
- Midterm Exam
- Magnetic Fields Due to Currents
- Electromagnetic oscillations and Alternating current
- Images
- Interference and Diffraction
- Relativity
- Photons and Matter Waves
- Nuclear Physics

**Teaching Methods Description**
- Lectures
- Recitation
- Experiments
- Presentations

**Assessment Methods Description (%)**
- Quiz: 20%
- Homework: 0%
- Project: 0%
- Midterm Exam: 20%
- Presentation: 10%
- Lab/Practical Exam: 0%
- Term Paper: 0%
- Attendance: 0%
- Class Deliverables: 10%
- Final Exam: 40%

**Learning Outcomes**
After completion of this course, students should be able to:
1. Define phenomena, concepts and terminology of electromagnetism, optics, atomic, and nuclear physics.
2. Gain experience in problem-solving in the field of electromagnetism, optics, atomic, and nuclear physics.
3. Develop capabilities to present a topic in the field of electromagnetism, optics, atomic, and nuclear physics.
4. Apply knowledge obtained to an engineering field.
5. Develop interpersonal and listening skills.

**Prerequisite Course(s)**
-

**Language of Instruction**
English

**Mandatory Literature**

**Recommended Literature**
- D.C. Giancoli: Physics for scientist and engineers, Prentice Hall, New Jersey, 2000
- The other sources from program fields. It is possible to use all books and Collection of problems on university level.

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
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<td>Final Examination (1 week)</td>
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Total Workload 154
ECTS Credit (Total Workload / 25) 6
Course Code: MTH 102  
Course Name: CALCULUS II

Level: Undergraduate  
Year: I  
Semester: II  
ECTS Credits: 6

Status: Compulsory  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description
Use of calculus is widespread in science, engineering, medicine, business, industry, and many other fields. Calculus also provides important tools in understanding functions and has led to the development of new areas of mathematics including real and complex analysis, topology, and non-Euclidean geometry.

Course Objectives
Objectives of this course are to: expand understanding of mathematical topics that may have been previously studied; introduce and explore topics that possibly have not been part of the student’s mathematical experience; develop an appreciation for the development of mathematical thought; learn the application of mathematics in real life problems and analyzing the results.

Course Content
- Vectors; Dot Products, Cross Products
- Lines and Planes, Polar Coordinates
- Surfaces and Coordinate Systems, Parameterized Curves
- Arc Length and Curvature, Velocity and Acceleration
- Functions of Several Variables, Limits, Continuity, Partial Derivatives
- Tangent Planes and Linear Approximation, Chain Rule
- Gradient, Directional Derivatives, 2nd Order Derivatives, Local Extrema
- Midterm Exam
- Local Extrema, Lagrange Multipliers
- Double Integrals, Iterated Integrals, Applications of Double Integrals
- Triple Integrals, Transformation of Coordinates
- Line Integrals In R2, Line Integrals in R3
- Surface Integrals
- Green’s Theorem, Stokes’ Theorem
- Divergence Theorem
- Problem solving
- Exercises

Teaching Methods Description
- Lectures
- Recitation
- Problem solving
- Exercises

Assessment Methods Description (%)  
Quiz  25 %  Lab/Practical Exam  0 %  
Homework  0 %  Term Paper  0 %  
Project  0 %  Attendance  0 %  
Midterm Exam  25 %  Class Deliverables  0 %  
Presentation  0 %  Final Exam  50 %

Total 100 %

Learning Outcomes
On successful completion of the course, the students should be able to:
1. Apply two and three dimensional Cartesian coordinate system.
2. Recognize and classify the equations and shapes of quadratic surfaces.
3. Recognize and construct the equations of lines and planes.
4. Operate with vector functions, find their derivatives and integrals, find the arc length.
5. Calculate the limits of multivariable functions and prove the nonexistence of a limit.
6. Find partial derivatives using the properties of differentiable multivariable functions and basic rules.

Prerequisite Course(s)
-

Language of Instruction
English

Mandatory Literature

Recommended Literature
- Calculus with Analytic Geometry, R.A. Silverman, Prentice Hall, 1985

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
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<tr>
<th>Activities</th>
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<th>Workload</th>
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<td>Laboratory / Practice (15 weeks x Laboratory / Practice hours per week)</td>
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Total Workload 147

ECTS Credit (Total Workload / 25) 6
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<th>Course Code: CEN 114</th>
<th>Course Name: DATABASE DESIGN AND IMPLEMENTATION</th>
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**Course Description**

This course focuses on designing and implementing relational database environment.

**Course Objectives**

Objectives of the course are to give understanding of basic concepts of relational databases and management systems, specification of user requests, database design using conceptual (entity-relationship model) and logical (relational) model, as well as the implementation using relational system for database management. Moreover, design database in accordance with the normalization, manipulation and management of data stored in the database will be done.

**Course Content**

- Database System Concepts and Architecture (1)
- Database System Concepts and Architecture (2)
- System analysis (1)
- System analysis (2)
- System analysis (3)
- Relational modelling (1)
- Relational modelling (2)
- Midterm Exam
- Relational modelling (3)
- Database design and implementation (1)
- Database design and implementation (2)
- Database design and implementation (3)
- Case study implementation (1)
- Case study implementation (2)
- Project presentation

**Teaching Methods Description**

- Interactive lectures
- Tutorial
- Practical sessions
- Presentations

**Assessment Methods Description (%)**

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<thead>
<tr>
<th>Quiz</th>
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<th>Lab/Practical Exam</th>
<th>0 %</th>
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<tbody>
<tr>
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<td>Term Paper</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
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<td>100 %</td>
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</table>

**Learning Outcomes**

After completion of this course, students should be able to:
1. Show understanding of database system concepts
2. Apply architecture system analysis
3. Show competences in the issues involved in physical database design as well as database security and performance
4. Design database using conceptual (entity-relationship model) and logical (relational) model
5. Implement database using relational system for database management

**Prerequisite Course(s)**

- English

**Mandatory Literature**

- Silberschatz, Korth, Database system concepts, McGrawHill

**Recommended Literature**

- Pro SQL Server 2012 Relational Database Design and Implementation (Professional Apress) by Louis Davidson and Jessica M. Moss

**ECTS (ALLOCATED BASED ON STUDENT'S WORKLOAD)**

<table>
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<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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<tr>
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<tr>
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<td>Course Code: CEN 257</td>
<td>Course Name: SYSTEM ANALYSIS AND DESIGN</td>
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**Course Description**

This course will provide overall foundation of systems analysis and design to effectively and efficiently design and implement system. Moreover, this course provides the opportunity to analyze, design, implement, and document the system development cycle. Course includes analysis of current systems, logical and physical systems design, program development, testing, implementation, maintenance, and documentation.

**Course Objectives**

The objectives of this course are to: introduce variety of new software used by analysts, designers to manage projects, analyze and document systems, design new systems and implement their plans; provide students with the basic knowledge of systems development life cycle; teach students a systems design strategy that emphasizes customer requirements at all stages of the process; introduce students to the object oriented design process; give students a full design experience on a small project such as designing an e-Commerce system; and show to students examples of the writing required for systems design and requiring them to write individual and team reports as well as give oral presentations on their designs.

**Course Content**

- Introduction to Systems Analysis and Design
- Investigating System Requirements
- Use Cases
- Process Modelling
- Extending the Requirements Models
- System Methodologies and Approaches
- Object Modelling (Use Case Diagrams, Activity Diagrams)
- Midterm Exam
- Object Modelling (Sequence Diagrams, Communication Diagrams)
- Object Modelling (Class Diagrams, Object Diagrams)
- Approaches to System Development
- Project Planning and Project Management
- Object Oriented Design Principles
- The Role of System Analyst
- Preparation for Final Exam

**Teaching Methods Description**

- Interactive lectures
- Tutorial
- Presentations
- Project

**Assessment Methods Description (%)**

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
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<tbody>
<tr>
<td>0%</td>
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<tr>
<td>10%</td>
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<tr>
<td>30%</td>
<td>Project</td>
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<td>20%</td>
<td>Midterm Exam</td>
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<tr>
<td>0%</td>
<td>Presentation</td>
</tr>
<tr>
<td>0%</td>
<td>Lab/Practical Exam</td>
</tr>
<tr>
<td>0%</td>
<td>Term Paper</td>
</tr>
<tr>
<td>0%</td>
<td>Attendance</td>
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<tr>
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<td>Class Deliverables</td>
</tr>
<tr>
<td>40%</td>
<td>Final Exam</td>
</tr>
</tbody>
</table>

**Total Workload: 125/100 = 5 ECTS**

**Learning Outcomes**

After completion of this course, students should be able to:
1. Describe the information systems development life cycle.
2. Demonstrate system analysis and design using structured and object oriented approaches.
3. Test, analyze and justify the selection of the most appropriate system development approach for the project.
4. Communicate a clear, coherent and independent exposition of systems analysis and design.
5. Solve a wide range of problems related to the analysis, design and construction of information systems.

**Prerequisite Course(s)**

- 

**Language of Instruction**

- English

**Mandatory Literature**


**Recommended Literature**


**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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</thead>
<tbody>
<tr>
<td>Lecture (15 weeks x Lecture hours per week)</td>
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<td>Laboratory / Practice (15 weeks x Laboratory / Practice hours per week)</td>
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**Total Workload: 125**

**ECTS Credit (Total Workload / 25): 5**
<table>
<thead>
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<th>Course Code: CEN 221</th>
<th>Course Name: OBJECT ORIENTED PROGRAMMING</th>
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<td>Status: Compulsory</td>
<td>Hours/Week: 3+2</td>
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**Course Description**
This course introduces students to the object oriented programming paradigm.

**Course Objectives**
The objective of this course is to let computer science students learn object oriented programming in a deep way and apply it to solve problems.

**Course Content**
- Review of C++ programming essentials (Loops, Functions, Arrays) (1)
- Review of C++ programming essentials (Loops, Functions, Arrays) (2)
- Introduction to Structures, Classes and Objects (1)
- Introduction to Structures, Classes and Objects (2)
- Designing and Implementing Classes
- Object-oriented design
- Strings and Vectors
- Midterm Exam
- Separate Compilation and Namespaces
- Streams
- Polymorphism
- Inheritance
- Recursion
- Exception Handling
- Templates

**Teaching Methods**
- Interactive Lectures and hand-on activities
- Reading Quizzes
- Laboratory practice
- Group Study

**Assessment Methods**

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**Learning Outcomes**
After completion of this course, students should be able to:
1. Define and describe objects.
2. Implement programs using object oriented design.
3. Demonstrate an understanding of the fundamental principles of object oriented programming.
4. Explain the difference between functional programming and object oriented programming.
5. Demonstrate an understanding of software engineering principles.

**Prerequisite Course(s)**
Programming I

**Language of Instruction**
English

**Mandatory Literature**
- Absolute C++, 5th ed, W. Savitch, Pearson

**Recommended Literature**
- Problem Solving with C++, 7th ed, W. Savitch, Pearson
- An Introduction to OOP, 3 edition, T. Budd, Pearson

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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| Total Workload | 133 |
| ECTS Credit (Total Workload / 25) | 5 |
# Course Details

**Course Code:** CEN 261  
**Course Name:** COMPUTER ORGANIZATION  
**Level:** Undergraduate  
**Year:** II  
**Semester:** III  
**ECTS Credits:** 5  
**Status:** Compulsory  
**Hours/Week:** 3+2  
**Total Hours:** 45+30

## Course Description
Computer organization is a science that deals with the understanding of the inner-workings of modern computer systems and trade-offs present at the hardware-software interface. Instruction set design and addressing modes, register transfer, internal CPU bus structure, ALU (microprogramming and hardwired control), computer arithmetic, memory system, input-output system.

## Course Objectives
The objective of the course is to teach students the essentials of computer organization and architecture. It focuses on the function and design of the various components necessary to process information digitally. Topics include instruction processing, instruction set, instruction format and addressing, hardwired vs microprogrammed control, memory interfacing, memory hierarchy, cache and virtual memory, input-output and storage systems.

## Course Content
- Data representation in Computer System, Numbering system, Signed Integer Representation, Floating point representation
- Error detection and correcting codes
- Fundamental Units of a Computer System General overview of CPU
- Memory, and I/O systems, their external interfacing
- Memory and Interfacing, Types of memory, and CPU memory interfacing
- Internals of CPU Fundamental units of a CPU
- Common Bus Structures and Signal Generation Sequences
- Midterm Exam
- Single bus, double bus structures
- Control signal generation sequences.
- Control Unit Hardwired and Microprogrammed control units.
- Instruction Sets, Formatting and Addressing Instruction processing, instruction set, instruction format and addressing
- Memory hierarchy and management, cache and virtual memory organizations
- Introduction to Input and Output Systems
- Input-output and storage system in a computer system, external devices, programmed or interrupt driven I/O, DMA

## Teaching Methods Description
- Interactive lectures and communications with students
- Tutorials

## Assessment Methods Description (%)
- Quiz 10 %  
- Lab/Practical Exam 0 %  
- Homework 10 %  
- Term Paper 0 %  
- Project 0 %  
- Attendance 0 %  
- Midterm Exam 30 %  
- Class Deliverables 0 %  
- Presentation 0 %  
- Final Exam 50 %

## Learning Outcomes
After completion of this course, students should be able to:
1. Describe the organization of a modern computer system and be able to relate them to real examples implemented in commercially successful products.
2. Describe the internal organization of a computer system through practicing with an assembly language.
3. Apply concepts and skills to solve real life problems using a low level programming language.
4. Provide framework for thinking about computer organization.
5. Continue the lifetime learning necessary for staying at the forefront of computing systems development.

## Prerequisite Course(s)

## Language of Instruction
English

## Mandatory Literature

## Recommended Literature

## ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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**Total Workload:** 124

**ECTS Credit (Total Workload / 25):** 5
**Course Code:** CEN 263  
**Course Name:** COMPUTER NETWORKS

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<th>Year: II</th>
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<td>Total Hours: 45+30</td>
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</table>

**Course Description**  
This course focuses on the principles and practice of computer networking, with emphasis on the Internet: the structure and components of computer networks, packet switching, layered architectures, TCP/IP, physical layer, error control, window flow control, local area networks (Ethernet, Token Ring, FDDI), network layer, congestion control, quality of service, multicast.

**Course Objectives**  
The main objective of this course is to answer the basic question "how do computer networks and internets operate?" in the broadest sense. The course will provide a comprehensive, self-contained tour through all of networking from the lowest levels of data transmission and wiring to the highest levels of application software. At each level, we will see how the facilities and services provided by lower levels are used and extended in the next level.

**Course Content**

| Course Content | | Course Content |
|----------------|------------------|
| Introduction to course | The Transport Layer (3) |
| Computer Networks and The Internet (1) | The Network Layer (1) |
| Computer Networks and The Internet (2) | The Network Layer (2) |
| Application Layer (1) | The Network Layer (3) |
| Application Layer (2) | The Link Layer (1) |
| Transport Layer (1) | The Link Layer (2) |
| Transport Layer (2) | The Physical Layer |
| Midterm Exam | |

**Teaching Methods Description**

- Interactive lectures
- Tutorial

**Assessment Methods Description (%)**

<table>
<thead>
<tr>
<th>Assessment Methods Description</th>
<th>Quantity</th>
<th>Duration</th>
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<tbody>
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<tr>
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<td>Midterm Exam</td>
<td>30 %</td>
<td>Class Deliverables</td>
</tr>
<tr>
<td>Presentation</td>
<td>0 %</td>
<td>Final Exam</td>
</tr>
</tbody>
</table>

**Total** 100 %

**Learning Outcomes**

After completion of this course, students should be able to:
1. Discuss basic computer network technology.
2. Discuss and explain Data Communications System and its components.
3. Identify the different types of network topologies and protocols.
4. Identify the layers of the OSI model and TCP/IP. Explain the function(s) of each layer.
5. Identify the different types of network devices and their functions within a network.
6. Demonstrate the skills of subnetting and routing mechanisms.

**Prerequisite Course(s)**

- 

**Language of Instruction**

- English

**Mandatory Literature**


**Recommended Literature**


**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
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<tbody>
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<td>Lecture (15 weeks x Lecture hours per week)</td>
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<td>3</td>
<td>45</td>
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<tr>
<td>Laboratory / Practice (15 weeks x Laboratory / Practice hours per week)</td>
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**Total Workload** 129

**ECTS Credit (Total Workload / 25)** 5
Course Code: MTH 203  
Course Name: DISCRETE MATHEMATICS

Level: Undergraduate  
Year: II  
Semester: III  
ECTS Credits: 5

Status: Compulsory  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description
This course provides mathematical foundations for computer science students. It introduces basic logic, set theory, proof techniques, relations, enumeration, and elements of graph theory.

Course Objectives
Objective of this course is to equip IT students with mathematical foundations that are essential to the discipline.

Course Content
- Formal Logic, Propositional Logic, Predicate Logic
- Logic in Mathematics, Methods of Proof
- Sets, Operations on sets
- Relations, partial orderings
- Equivalence relations and equivalence classes
- Functions, one-to-one, onto functions, bijections
- Mathematical Induction

- Midterm Exam
- Recurrence Relations
- Basic Counting Techniques
- Basic graph theory
- Euclidian and Hamiltonian paths and cycles
- Trees
- Growth of Functions
- Algorithm Analysis

Teaching Methods Description
- Interactive Lectures
- Reading Quizzes
- Student Presentations
- Group Study

Assessment Methods Description (%)
- Quiz 15 %  
  - Lab/Practical Exam 0 %
- Homework 20 %  
  - Term Paper 0 %
- Project 0 %  
  - Attendance 15 %
- Midterm Exam 20 %  
  - Class Deliverables 0 %
- Presentation 0 %  
  - Final Exam 30 %

Total 100 %

Learning Outcomes
After completion of this course, students should be able to:
1. Form rigorous arguments to justify mathematical assertions.
2. Evaluate and critique logical and mathematical arguments.
3. Communicate effectively with engineering community and with general public.
4. Apply basic logic, set theory, counting techniques and other mathematical ideas in computer science.
5. Demonstrate an understanding and appreciation of formal mathematics.
6. Analyze running times of algorithms.

Prerequisite Course(s)

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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Total Workload 128

ECTS Credit (Total Workload / 25) 5
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**Course Description**
This is an introductory course to operating systems. Operating systems are an essential part of any computer system. Operating systems vary significantly, but their fundamental principles remain the same.

**Course Objectives**
In this course you will be introduced to the basic concepts of operating systems, see how they manage resources such as memory, peripherals, and schedule CPU time, learn how to use the system call interface and how to create processes and synchronize them, learn how applications communicate, understand the memory hierarchy and see how virtual memory is managed, understand how files are managed and stored, and much more.

**Course Content**
- Computer System Overview
- Operating System Overview
- Process Concept
- Process Scheduling
- Threads (1)
- Threads (2)
- Exam Preparation
- Midterm Exam
- Synchronization
- Memory Management
- Virtual Memory
- Demand Paging and Segmentation
- File management
- I/O Management System
- Protection and Security

**Teaching Methods**
- Interactive lectures and communications with students
- Tutorials
- Labs

**Assessment Methods**
- Quiz 0 % Lab/Practical Exam 10 %
- Homework 15 % Term Paper 0 %
- Project 15 % Attendance 0 %
- Midterm Exam 25 % Class Deliverables 0 %
- Presentation 0 % Final Exam 35 %

Total 100 %

**Learning Outcomes**
After completion of this course, students should be able to:
1. Describe the basic principles used in the design of modern operating systems.
2. Describe how computing resources (such as CPU and memory) are managed by the operating system.
3. Summarise techniques for achieving synchronisation in an operation system.
4. Compare and contrast the common algorithms used for both pre-emptive and non-pre-emptive scheduling of tasks in operating systems, such a priority, performance comparison, and fair-share schemes.
5. Explain memory hierarchy and cost-performance trade-offs.

**Prerequisite Course(s)**

**Language of Instruction**
English

**Mandatory Literature**

**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
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**Total Workload**
129

**ECTS Credit (Total Workload / 25)**
5

28
### Course Code: MTH 205  
### Course Name: PROBABILITY AND STATISTICS FOR ENGINEERS

<table>
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#### Course Description
- This course on uncertainty in engineering analysis can also be referred to as probability and statistics for engineers. In particular, we will deal with the applications of probability and statistics.

#### Course Objectives
- The objective of this course is to give students understanding of following topics: the role of statistics in engineering, probability, discrete random variables and probability distributions, continuous random variables and probability distributions, joint probability distributions, random sampling and data description, point estimation of parameters, statistical intervals for a single sample, and tests of hypotheses for a single sample.

#### Course Content
- **Introduction to Probability and Statistics**
- **Descriptive Statistics**
- **Numerical Methods**
- **Probability**
- **Bayes Theorem and Random Variables**
- **Discrete Probability**
- **Continuous Random Variables**
- **Midterm Exam**
- **Joint probability distribution**
- **Sampling distribution and point estimation (1)**
- **Sampling distribution and point estimation (2)**
- **The Central Limit Theorem**
- **Confidence interval**
- **Variance known/unknown**
- **Preparation for Final Exam**

#### Teaching Methods Description
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Presentations

#### Assessment Methods Description (%)
- **Quiz** 0 %
- **Lab/Practical Exam** 0 %
- **Homework** 10 %
- **Term Paper** 0 %
- **Project** 20 %
- **Attendance** 10 %
- **Midterm Exam** 20 %
- **Class Deliverables** 0 %
- **Presentation** 10 %
- **Final Exam** 30 %

#### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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**Total Workload**: 130

**ECTS Credit (Total Workload / 25)**: 5

---

**Learning Outcomes**
- After completion of this course, students should be able to:
  1. Apply statistical methodology and tools in the engineering problem-solving process.
  2. Compute and interpret descriptive statistics using numerical and graphical techniques.
  3. Show a capacity for investigation and experimentation into physical (engineering) phenomena.
  4. Compute point estimation of parameters, explain sampling distributions, and understand the central limit theorem.
  5. Construct confidence intervals on parameters for a single sample.

**Prerequisite Course(s)**

**Language of Instruction**: English

**Mandatory Literature**

**Recommended Literature**

---

29
<table>
<thead>
<tr>
<th>Course Code: CEN 254</th>
<th>Course Name: DATA STRUCTURES</th>
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<tbody>
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<tr>
<td>Status: Compulsory</td>
<td>Semester: IV</td>
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<td>ECTS Credits: 5</td>
<td>Total Hours: 45+30</td>
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**Course Description**
This course covers basic data structures that are used in programming. Implementation and applications of various data structures together with analysis of algorithms are discussed.

**Course Objectives**
Objective of the course is to introduce to students basic data structures and their implementations: array based lists, linked lists, stacks, queues, hash tables, trees, and graphs; programming techniques using recursion; various searching and sorting methods such as insertion sort, merge sort, and quick sort and basic analysis of algorithms.

**Course Content**
- Review of Object-oriented programming
- Containers, array based list
- Linked Lists (1)
- Linked Lists (2)
- recursion
- Stacks (1)
- Stacks (2)
- Midterm Exam
- Queues (1)
- Queues (2)
- Trees
- Binary Trees, Binary Search Trees
- Graphs
- Graph Algorithms
- Hashing

**Teaching Methods**
- Interactive lectures
- Tutorial

**Assessment Methods**

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<tr>
<th>Description (%)</th>
<th>Quiz</th>
<th>Lab/Practical Exam</th>
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<td></td>
<td>35 %</td>
<td>Attendance</td>
<td>10 %</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>15 %</td>
<td>Class Deliverables</td>
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</tr>
<tr>
<td>Presentation</td>
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<td>Final Exam</td>
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<td><strong>Total</strong></td>
<td><strong>100 %</strong></td>
<td></td>
<td><strong>100 %</strong></td>
</tr>
</tbody>
</table>

**Learning Outcomes**
After completion of this course, students should be able to:
1. Demonstrate an understanding of the basic data structures.
2. Explain the difference between various sorting algorithms.
3. Implement various data structures.
4. Demonstrate how data structures are used in programming.
5. Analyze computational complexity of basic algorithms.

**Prerequisite Course(s)**
Programming I

**Language of Instruction**
English

**Mandatory Literature**

**Recommended Literature**
- M. A. Weiss, Data Structures and Algorithm Analysis in C++, Addison Wesley, 2006

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
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<th>Workload</th>
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Course Code: CEN 234  
Course Name: INTRODUCTION TO MOBILE PROGRAMMING  
Level: Undergraduate  
Year: II  
Semester: IV  
ECTS Credits: 5

Status: Compulsory  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description: The course teaches students how to write mobile applications different fundamental programming languages. The course will lead the students through the essential concepts, tools, and techniques for developing applications. After completing this course, the students will have the knowledge and skills needed to create applications.

Course Objectives: The main objective of this course is to teach students how to apply theory with the help of relevant tools in building the application in mobile environment, in different purposes.

Course Content:
- The Android Platform
- The Android Development Environment
- Application Fundamentals
- The Activity Class
- The Intent Class
- Permissions
- The Fragment Class
- Midterm Exam
- User Interface Classes
- User Notifications
- Broadcast Receiver and Alarms
- Networking
- Graphics and Animation
- Location and Maps
- Data Management

Teaching Methods:
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Homework

Assessment Methods:
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<th>Description</th>
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<th>Homework</th>
<th>Term Paper</th>
<th>Project</th>
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<th>Midterm Exam</th>
<th>Class Deliverables</th>
<th>Presentation</th>
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<td>0 %</td>
<td>0 %</td>
<td>40 %</td>
<td>100 %</td>
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</table>

Learning Outcomes: After completion of this course, students:
1. Apply theory, techniques and relevant tools for simple and complex mobile application development.
2. Describe the concept of mobile application development.
3. Test the mobile application on the actual device.
4. Develop splitview application.
5. Develop touch based application.

Prerequisite Course(s): Programming I

Language of Instruction: English

Mandatory Literature:
- http://developer.android.com/

Recommended Literature:

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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**Course Code:** CEN 236  
**Course Name:** INTRODUCTION TO WEB PROGRAMMING

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**Course Description**
This course will provide students with a comprehensive mastery of HyperText Markup Language (HTML) coding practices. Additional topics include an understanding and use of XHTML, Cascading Style Sheets (CSS), and Validation according to the guidelines of the World Wide Web Consortium (W3C). Students will create an entire website using HTML and CSS. Moreover, students will learn Entity Framework, Razor, MVC patterns and how to deploy all together.

**Course Objectives**
Objective of the course is to teach students how to: build web pages using standards and validate web pages according to the rules published by the W3C; use an IDE (Integrated Development Environment) to implement and deploy a web application; deploy rich web applications that implement logic at the client and server side; apply the MVC (Model-View-Controller) to a Web application that uses a database and updates information.

**Course Content**
- Introduction to the World Wide Web and Web standards
- HyperText Markup Language (HTML5)
- Cascading Style Sheet (CSS)
- JavaScript
- Introduction to developing Web application using C#
- Introduction to LINQ
- Introduction to Entity Framework
- Midterm Exam
- Introduction to Razor
- Introduction to Model-View-Controller (MVC) pattern
- Controllers and Actions
- Views
- Model binding and validation
- Application deployment

**Teaching Methods Description**
- Lectures
- Practical Sessions
- Project
- Assignments

**Assessment Methods Description (%)**
- Quiz 0 %  
- Homework 0 %  
- Project 35 %  
- Midterm Exam 20 %  
- Presentation 0 %  
- Lab/Practical Exam 0 %  
- Term Paper 0 %  
- Attendance 5 %  
- Class Deliverables 0 %  
- Final Exam 40 %  

**Learning Outcomes**
After completion of this course, students should be able to:
1. Demonstrate understanding of (X)HTML5+CSS programming.
2. Explain the functions of clients and servers on the Web.
3. Show understanding of the logic behind advanced web applications.
4. Design and implement an interactive web site(s) with regard to issues of usability, accessibility and internationalization.
5. Apply the MVC (Model-View-Controller) to a Web application that uses a database and updates information.

**Prerequisite Course(s)**
Programming I

**Language of Instruction**
English

**Mandatory Literature**

**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
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<th>Workload</th>
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**Total Workload** 134

**ECTS Credit (Total Workload / 25)** 5
**Course Code:** CEN 300  
**Course Name:** INDUSTRIAL TRAINING

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<td>Semester:</td>
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**Status:** Compulsory  
**Hours/Week:** 0  
**Total Hours:** 0

**Course Description**

Students must complete a 30 business-day (6 weeks) summer practice in a software company or in the IT department of any type of company. Students are expected to learn about a real business and work environment and get involved in many aspects of software development process. Observations from industrial training must be documented and presented in the form of a clear and concise technical report.

**Course Objectives**

The purpose of Industrial Training is to expose students to real work of environment experience and at the same time, to gain the knowledge through hands on observation and job execution. From the industrial training, the students will also develop skills in work ethics, communication, management and others. Moreover, this practical training program allows students to relate theoretical knowledge with its application in the industry.

**Course Content**

**Teaching Methods Description**

- Interactive Learning in a company

**Assessment Methods Description (%)**

<table>
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<th>Description</th>
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<th>Homework</th>
<th>Term Paper</th>
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**Total Workload**  
**ECTS Credit (Total Workload / 25)**

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**Total Workload**

250

**ECTS Credit (Total Workload / 25)**

10
**Course Code:** CEN 333  
**Course Name:** SOFTWARE VERIFICATION, VALIDATION AND TESTING  
**Level:** Undergraduate  
**Year:** III  
**Semester:** V  
**ECTS Credits:** 5  
**Status:** Compulsory  
**Hours/Week:** 3+2  
**Total Hours:** 45+30

### Course Description
This course covers methods for evaluating software for correctness and reliability, including code inspections, program proofs and testing methodologies; formal and informal proofs of correctness; code inspections and their role in software verification; unit and system testing techniques, testing tools and limitations of testing; statistical testing, reliability models.

### Course Objectives
The objective of the course is to train students in the principles and techniques of validating and verifying software systems. The training will be intellectually demanding and will cover not only the state-of-the-practice in validation and verification, but also the most significant trends, problems and results in validation and verification research.

### Course Content

<table>
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<tr>
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<td>Static and dynamic analysis</td>
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<td>Black Box Testing: input partitioning and combinatorial testing</td>
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### Teaching Methods Description
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions

### Assessment Methods Description (%)

<table>
<thead>
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<th>Activity</th>
<th>Quantity</th>
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<tbody>
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<tr>
<td>Presentation</td>
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<td>30 %</td>
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</tbody>
</table>

### Learning Outcomes
After completion of this course, students should be able to:

1. Demonstrate knowledge and understanding of correctness, consistency, faults and failures, static analysis and testing.
2. Demonstrate understand the use of logic as a formal language for the specification of systems.
3. Demonstrate understand the use of symbolic execution, and the main verification techniques used in symbolic model checking, and be able to verify simple systems.
4. Demonstrate a good understanding of the range of approaches to testing that can be applied to software systems and be able to undertake both black-box and white-box (unit-level) testing.
5. Appreciate the limitations of the current tools and have insights in ongoing research topics to overcome them.

### Prerequisite Course(s)
- 

### Language of Instruction
- English

### Mandatory Literature

### Recommended Literature
- 

### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
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</table>

**Total Workload**

**ECTS Credit (Total Workload / 25)**

5
# Course: DATABASE SYSTEMS

**Course Code:** CEN 335  
**Course Name:** DATABASE SYSTEMS  
**Level:** Undergraduate  
**Year:** III  
**Semester:** V  
**ECTS Credits:** 5  
**Status:** Compulsory  
**Hours/Week:** 3+2  
**Total Hours:** 45+30

## Course Description
Database management is a course designed for the efficient and effective storage, access and update of relational database systems based on SQL language.

## Course Objectives
Objective of the course is to introduce students to the concepts of database management using SQL and database tools.

## Course Content

<table>
<thead>
<tr>
<th>Topic</th>
<th>Description</th>
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<tbody>
<tr>
<td>Introduction to DBMS (1)</td>
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<td>Introduction to DBMS (2)</td>
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<tr>
<td>Language SQL - DML commands (1)</td>
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<tr>
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</tr>
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<td>Language SQL - DDL commands (2)</td>
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<tr>
<td>Midterm Exam</td>
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<td>Language SQL - DDL commands (3)</td>
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<tr>
<td>Administration DBMS environments (1)</td>
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<tr>
<td>Administration DBMS environments (2)</td>
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<td>Administration DBMS environments (3)</td>
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<td>Advanced topics (1)</td>
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<td>Advanced topics (2)</td>
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<tr>
<td>Project presentations</td>
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## Teaching Methods

<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lectures</td>
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<td>3</td>
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<tr>
<td>Practical Sessions</td>
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<td>2</td>
<td>30</td>
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<tr>
<td>Project</td>
<td>1</td>
<td>2</td>
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</tr>
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<td>Assignments</td>
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<td>10</td>
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<td>1</td>
<td>20</td>
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</tr>
<tr>
<td>Term Paper</td>
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<tr>
<td>Final Exam</td>
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## Assessment Methods

<table>
<thead>
<tr>
<th>Description (%)</th>
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<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz</td>
<td>0 %</td>
<td>Lab/Practical Exam</td>
<td>0 %</td>
</tr>
<tr>
<td>Homework</td>
<td>0 %</td>
<td>Term Paper</td>
<td>0 %</td>
</tr>
<tr>
<td>Project</td>
<td>20 %</td>
<td>Attendance</td>
<td>10 %</td>
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<tr>
<td>Midterm Exam</td>
<td>20 %</td>
<td>Class Deliverables</td>
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<td>Final Exam</td>
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<td>Total</td>
<td>100 %</td>
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</table>

## Learning Outcomes
After completion of this course, students should be able to:

1. Retrieve useful data from a database by using complicated queries in the standard SQL database query language.
2. Administer most common DBMS.
3. Implement a database solution to an information technology problem.
4. Develop sophisticated queries to extract information from large datasets.
5. Recognize the issues related to database performance.

## Prerequisite Course(s)
- 

## Language of Instruction
English

## Mandatory Literature
- Writing T-SQL Queries for Beginners Using Microsoft SQL Server 2012 by Jasmin Azemović, Denis Mušić, Mattias Lind (MVP-Press)

## Recommended Literature
- Silberschatz, Korth, Database system concepts, McGrawHill
- Microsoft® SQL Server 2012 T-SQL Fundamentals by Itzik Ben-Gan

## ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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<tbody>
<tr>
<td>Lecture (15 weeks x Lecture hours per week)</td>
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<td>Laboratory / Practice (15 weeks x Laboratory / Practice hours per week)</td>
<td>15</td>
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<td>30</td>
</tr>
<tr>
<td>Midterm Examination (1 week)</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Final Examination (1 week)</td>
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<td>2</td>
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<tr>
<td>Preparation for Midterm Examination</td>
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**Course Code:** CEN 334  
**Course Name:** INTRODUCTION TO HUMAN-COMPUTER INTERACTION  
**Level:** Undergraduate  
**Year:** III  
**Semester:** VI  
**ECTS Credits:** 5  
**Status:** Compulsory  
**Hours/Week:** 3+2  
**Total Hours:** 45+30  

### Course Description
This course cover methods and principles of human-computer interaction, human-centred design and development of interactive systems, task-centred system design, user-centred design, qualitative and quantitative methods for evaluating interactive systems with users, graphical screen design, design principles and usability heuristics.

### Course Objectives
Objective of this course is to give students theoretical knowledge and practical experiences in the fundamental aspects of designing and evaluating interfaces; idea about what is meant by good design; variety of simple methods for evaluating the quality of an interface.

### Course Content
- Introduction to Human-Computer Interaction
- Task-centred system design
- User-centred design and prototyping
- Qualitative methods for evaluation of interfaces with users
- Psychology of everyday things
- Midterm Exam
- Return and discuss Assignment 1
- Beyond screen design
- Graphical screen design
- Return and discuss Assignment 3
- Design principles and usability heuristics
- Assignment 3 due
- Past and future of HCI

### Teaching Methods Description
- Interactive lectures
- Tutorials

### Assessment Methods Description (%)

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Quantity</th>
<th>Duration</th>
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<tbody>
<tr>
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<td>Lab/Practical Exam</td>
</tr>
<tr>
<td>Homework</td>
<td>10 %</td>
<td>Term Paper</td>
</tr>
<tr>
<td>Project</td>
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<td>Attendance</td>
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<tr>
<td>Midterm Exam</td>
<td>20 %</td>
<td>Class Deliverables</td>
</tr>
<tr>
<td>Preparation</td>
<td>0 %</td>
<td>Final Exam</td>
</tr>
</tbody>
</table>

**Total:** 100 %

### Learning Outcomes
After completion of this course, students should be able to:
1. Explain the Human Computer Interaction (HCI) fundamentals.
2. Explain how HCI can be incorporated in the software development process.
3. Implement an interface, or to be a part of the interface design team in a qualified manner.
4. Recognize requirements and specifications for the design as well as to understand the user.
5. Design prototypes and come up with methods and criteria for evaluation of the design.

### Prerequisite Course(s)

### Language of Instruction
English

### Mandatory Literature

### Recommended Literature
- Brooksheer J. G., 2005: Computer Science: An Overview, 8/E, Addison-Wesley

### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
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<tr>
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<tr>
<td>Final Examination (1 week)</td>
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<td>Seminar / Presentation</td>
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**Total Workload:** 125

**ECTS Credit (Total Workload / 25):** 5
### Course Code: CEN 392  
**Course Name:** SENIOR DESIGN PROJECT

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#### Course Description
This is an independent study under the supervision of an advisor: Research on exploring and defining a potential study area suitable for a senior design project; Identification of a specific problem from the selected study area in computer science and engineering; Results from this study are documented and presented in the form of a design project proposal; Design and implementation of the project proposed; Presentation of the results in both oral and written forms.

#### Course Objectives
Objective of Senior Design Project is to give students understanding of how to do research, trying to explore, define, and identify a specific computer engineering problem; document the research results with a proposal of a design project; conceive, design, and implement a hardware or software project proposed; document the results; present the implemented project orally.

#### Course Content

<table>
<thead>
<tr>
<th>Teaching Methods Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Project implementation</td>
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<table>
<thead>
<tr>
<th>Assessment Methods Description (%)</th>
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<tbody>
<tr>
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<td>Term Paper</td>
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<td>Class Deliverables</td>
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<tr>
<td>Presentation</td>
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<tr>
<td>Total</td>
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#### Learning Outcomes
After completion of this course, students should be able to:
1. Apply knowledge of mathematics, science, and engineering.
2. Design and conduct experiments as well as to analyze and interpret data.
3. Identify, formulate, and solve engineering problems using techniques, and modern engineering tools essential for engineering practice.
5. Communicate effectively both orally and in writing.

#### Prerequisite Course(s)
- 

#### Language of Instruction
English

#### Mandatory Literature

#### Recommended Literature

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
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<p>| ECTS Credit (Total Workload / 25) | 10 |</p>
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<th>Course Code: GDM 107</th>
<th>Course Name: BASICS OF COMPUTER GRAPHIC</th>
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<tbody>
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<tr>
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<tr>
<td>Hours/Week: 2+1</td>
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</table>

**Course Description**
Through this course, students are introduced to the logic of displaying and processing digital images and graphics on the computer.

**Course Objectives**
The aim of the course is to familiarize students with digital image bases as well as program packages for this purpose. Further, the goal is to enable students to use the tools needed to process, monitor and print.

**Course Content**
- Basic theoretical knowledge about the creation of a digital image.
- Basic program packages required for field work.
- Digitizing, processing, editing and printing images.
- Vectors.
- Basics of multimedia tools.
- Current trends in information technology with a particular focus on graphic and multimedia technologies.

**Teaching Methods Description**
The course consists of introductory lectures on individual topics as well as practical demonstrations, followed by practical sessions.

**Assessment Methods Description (%)**
- Quiz 0 % Practical Exercises 20 %
- Homework 0 % Term Paper 0 %
- Activity 0 % Attendance 0 %
- Midterm Exam 30 % Class Deliverables 0 %
- Presentation 10 % Final Exam 40 %
- Total 100 %

**Learning Outcomes**
By mastering the course content, students will acquire basic knowledge of computer graphics applied in the field of visual communication design. They will also master the skills for individual work with the program tools needed in this field.

**Prerequisite Course(s)**
-

**Language of Instruction**
English

**Mandatory Literature**

**Recommended Literature**
- D. Gookin, PC for Dummies, John Wiley and Sons (2013). Internet resources and technical magazines.

**ECTS (ALLOCATED BASED ON STUDENT'S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture (15 weeks x Lecture hours per week)</td>
<td>15</td>
<td>2</td>
<td>30</td>
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<tr>
<td>Laboratory / Practice (15 weeks x Laboratory / Practice hours per week)</td>
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<td>1</td>
<td>15</td>
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<tr>
<td>Midterm Examination (1 week)</td>
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<td>2</td>
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<tr>
<td>Final Examination (1 week)</td>
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<td>2</td>
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<tr>
<td>Preparation for Midterm Examination</td>
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<tr>
<td>Preparation for Final Examination</td>
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</tr>
<tr>
<td>Assignment / Homework / Project / Practical Exercises</td>
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<tr>
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<tr>
<td>Total Workload</td>
<td></td>
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</tbody>
</table>

**ECTS Credit (Total Workload / 25)**
5
Course Code: CEN 304  |  Course Name: AUTOMATA THEORY AND FORMAL LANGUAGES
---|---
Level: Undergraduate  |  Year: III  |  Semester: VI  |  ECTS Credits: 5
Status: Elective  |  Hours/Week: 3+2  |  Total Hours: 45+30

**Course Description**
Regular expressions, context free grammars and languages. Pumping lemma, finite and pushdown automata, Chomsky hierarchy, Turing machines, computability theory, determinism and non-determinism, recursive function theory.

**Course Objectives**
A variety of formal models for machines and languages are explored including machines with memory (the finite-state, random-access and Turing machines), language models (regular expressions and formal languages) and complexity classes identifying problems with the same general complexity, such as the NP-complete problems.

**Course Content**
- Background Material
- Inductive Proofs
- Finite Automata
- Regular Languages
- Regular Expressions
- Properties of Regular Languages
- Context-free Grammars
- Pumping lemma
- Pushdown Automata
- Properties of Context-free Languages
- Turing Machines
- Undecidability
- Intractable Problems
- Preparation for Final Exam

**Teaching Methods**
- Interactive lectures
- Tutorial

**Assessment Methods**
- Quiz: 10%
- Homework: 10%
- Project: 20%
- Midterm Exam: 20%
- Presentation: 0%
- Lab/Practical Exam: 0%
- Term Paper: 0%
- Attendance: 0%
- Class Deliverables: 0%
- Final Exam: 40%

**Learning Outcomes**
1. Explain and manipulate the different concepts in automata theory and formal languages such as formal proofs, (non-)deterministic automata, regular expressions, regular languages, context-free grammars, context-free languages, Turing machines.
2. Explain the power and the limitations of regular languages and context-free languages
3. Prove properties of languages, grammars and automata with rigorously formal mathematical methods
4. Design automata, regular expressions and context-free grammars accepting or generating a certain language
5. Describe the language accepted by an automata or generated by a regular expression or a context-free grammar.

**Prerequisite Course(s)**
- 

**Language of Instruction**
English

**Mandatory Literature**

**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture (15 weeks x Lecture hours per week)</td>
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<td>30</td>
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<tr>
<td>Midterm Examination (1 week)</td>
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<tr>
<td>Final Examination (1 week)</td>
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<tr>
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<tr>
<td><strong>Total Workload</strong></td>
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<td>125</td>
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</table>

| ECTS Credit (Total Workload / 25) | | | 5 |
Course Code: CEN 306  
Course Name: ANALYSIS OF ALGORITHMS

Level: Undergraduate  
Year: III  
Semester: VI  
ECTS Credits: 5

Status: Elective  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description
This course teaches the principles of algorithm design and analysis. The students will be introduced to techniques such as the greedy approach, divide and conquer, dynamic programming, etc. The efficiency of various algorithms will be examined in terms of the time and space complexity.

Course Objectives
Objectives of the course are to introduce students to the general tools and techniques for analyzing computer algorithms and to equip them with mathematical preliminaries required to analyze and design computer algorithms.

Course Content
- Basics of Algorithm Analysis
- O(n^2) Sorting Algorithms
- Hashing
- O(log(n)) Sorting Algorithms
- Balanced Search Trees
- String Matching
- Horner's Rule and Binary Exponentiation
- Midterm Exam
- Extended Euclid's Algorithm
- Greedy Technique
- Exhaustive Search
- Dynamic Programming (optional)
- Computational Intractability
- P vs. NP question
- Project presentation

Teaching Methods
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions

Assessment Methods
- Quiz 0 %
- Lab/Practical Exam 0 %
- Homework 20 %
- Term Paper 0 %
- Project 20 %
- Attendance 0 %
- Midterm Exam 20 %
- Class Deliverables 0 %
- Presentation 0 %
- Final Exam 40 %

Total 100 %

Learning Outcomes
After completion of this course, students should be able to:
1. Understand a number of most commonly used algorithms and the underlying concepts
2. Implement a given algorithm
3. Analyze the asymptotic performance of algorithms
4. Apply efficient algorithms to practical engineering problems
5. Argue the correctness of algorithms using inductive proofs and loop invariants

Prerequisite Course(s)
-

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
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Total Workload 128

ECTS Credit (Total Workload / 25) 5
Course Code: CEN 311  
Course Name: INTRODUCTION TO WEB ENGINEERING

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Course Description
Provides an introduction to the discipline of Web Engineering. This course aims to introduce the methods and techniques used in Web-based system development. The course addresses the concepts, methods, technologies, and techniques of developing Web sites that collect, organize and expose information resources. Topics covered include requirements engineering for Web applications, design methods and technologies, interface design, usability of web applications, accessibility, testing, metrics, operation and maintenance of Web applications, security, and project management.

Course Objectives
The objective of this course is to provide students with the fundamental concepts necessary to better engineer Web applications. The course covers fundamental concepts behind Web engineering, approaches in web usability and web application testing, and technologies supporting Web engineering.

Course Content
- An Introduction to Web Engineering
- Requirements Engineering for Web Applications
- Modeling Web Applications
- Web Application Architectures
- Technology-aware Web Application Design
- Usability of Web Applications
- Technologies for Web Applications
- Midterm Exam
- Web Project Management
- The Web Application Development Process
- Security for Web Applications
- Testing of Web Applications
- Operation & Maintenance of Web Applications
- AJAX
- Preparation for Final Exam

Teaching Methods Description
- Interactive lectures
- Tutorial
- Project
- Homework
- Quiz 10 %
- Labor/Practical Exam 0 %
- Lab/Practical Exam 0 %
- Homework 0 %
- Term Paper 0 %
- Project 30 %
- Attendance 0 %
- Midterm Exam 20 %
- Class Deliverables 0 %
- Presentation 0 %
- Final Exam 40 %

Assessment Methods Description (%)

Learning Outcomes
After completion of this course, students should be able to:
1. Develop a web application using server side programming languages and components.
2. Apply the web engineering methodologies for Web application development.
3. Select an appropriate testing strategy for web applications.
4. Identify the potential problems and issues in developing web applications.
5. Differentiate between different development processes.

Prerequisite Course(s)
Programming I

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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Total Workload 129

ECTS Credit (Total Workload / 25) 5
### Course Code: CEN 321  
### Course Name: INTRODUCTION TO LOGIC PROGRAMMING

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#### Course Description
Logic has been called "the calculus of computer science". The argument is that logic plays a fundamental role in computer science, similar to that played by calculus in the physical sciences and traditional engineering disciplines. Indeed, logic plays an important role in areas of Computer Science as disparate as architecture (logic gates), software engineering (specification and verification), programming languages (semantics, logic programming), databases (relational algebra and SQL), artificial intelligence (automatic theorem proving), algorithms (complexity and expressiveness), and theory of computation.

#### Course Objectives
The objective of the course will be to introduce the main notions of mathematical logic: logical notations (syntax) and how to assign meaning to them (semantics). We will motivate some uses for mathematical logic in the field of computer science. We will then study formal frameworks (in the sense of being rigorous as well as in the sense of manipulating "form") for constructing logical arguments (proof theory), studying in particular some deductive systems for propositional and first-order logic.

#### Course Content
- Review of the principle of mathematical induction
- The principle of structural induction
- Review of Boolean algebras
- Syntax of propositional formulas
- Truth and the semantics of propositional logic
- Notions of satisfiability, validity, inconsistency;
- Deduction systems for propositional logic
- Midterm Exam
- Completeness of a deductive system
- First order logic
- Proof theory for FOL
- Introduction to model theory
- Completeness and compactness theorems
- First order theories
- Preparation for Final Exam

#### Teaching Methods Description
- Interactive lectures and communications with students
- Tutorials

#### Assessment Methods Description (%)
- Quiz: 10 %
- Lab/Practical Exam: 0 %
- Homework: 10 %
- Term Paper: 0 %
- Project: 20 %
- Attendance: 0 %
- Midterm Exam: 20 %
- Class Deliverables: 0 %
- Presentation: 0 %
- Final Exam: 40 %

#### Learning Outcomes
After completion of this course, students should be able to:
1. Analyze and compare the characteristics of different reasoning systems and different solutions to programming problems.
2. Design and implement solutions to a number range of problems.
3. Participate in weekly class discussion and to write a report on a particular aspect of the course material.
4. Analyze and compare the characteristics of formal framework for constructing logical arguments.
5. Solve problems in and using logic programming.

#### Prerequisite Course(s)
- 

#### Language of Instruction
- English

#### Mandatory Literature

#### Recommended Literature

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### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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**Total Workload**: 129

**ECTS Credit (Total Workload / 25)**: 5

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42
**Course Code:** CEN 331  
**Course Name:** INTRODUCTION TO PROGRAMMING LANGUAGE DESIGN

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</table>

**Course Description**

Lexical and syntax analysis, top-down and bottom-up parsing techniques, semantic analysis, symbol tables, error detection and recovery, type checking, code generation and optimization. Case study: Implementation of a compiler for a simple but nontrivial subset of a modern programming language. Basic computer literacy, fundamentals of computer programming, algorithm development and problem solving using flowcharts and pseudo codes, data types, constants, variables, basic input/output, sequences, selection and repetition structures, functions and arrays. Searching and sorting, abstract data types, structures, pointers, strings, input/output, file processing.

**Course Objectives**

The objectives of this course are to develop a basic understanding of programming concepts and using these programming concepts in C language. Structured programming concept is introduced. Programming constructs such as sequential structures, selection structures, and repetition structures are explained. As for introduction to programming with C languages, variables, if-then-else, loop structures: for/while/do-while, break/continue/switch statements, flowcharting solutions, arrays are covered.

**Course Content**

- Course Introduction
- Data types
- Structured Programming
- Control structures (1)
- Control structures (2)
- Control structures (3)
- Control structures (4)
- Midterm Exam
- Functions (1)
- Functions (2)
- Functions (3)
- Functions (4)
- Arrays (1)
- Arrays (2)
- Arrays (3)

**Teaching Methods**

- Interactive lectures and communications with students
- Tutorials

**Assessment Methods**

- Quiz: 10 %
- Homework: 10 %
- Project: 20 %
- Midterm Exam: 20 %
- Presentation: 0 %
- Lab/Practical Exam: 0 %
- Term Paper: 0 %
- Attendance: 0 %
- Class Deliverables: 0 %
- Final Exam: 40 %

**Total** 100 %

**Learning Outcomes**

After completion of this course, students should be able to:

1. Develop a greater understanding of the issues involved in programming language design and implementation.
2. Develop an in-depth understanding of functional, logic, and object-oriented programming paradigms.
3. Implement several programs in languages other than the one emphasized in the core curriculum (Java/C++)
4. Understand design/implementation issues involved with variable allocation and binding, control flow, types, subroutines, parameter passing.
5. Develop an understanding of the compilation process.

**Prerequisite Course(s)**

- 

**Language of Instruction**

- English

**Mandatory Literature**


**Recommended Literature**

- 

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

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**Total Workload** 119

**ECTS Credit (Total Workload / 25)** 5
**Course Code:** CEN 332  
**Course Name:** PROGRAMMING LANGUAGES

**Level:** Undergraduate  
**Year:** III  
**Semester:** VI  
**ECTS Credits:** 5

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<th>Status</th>
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**Course Description**

Programming Languages: Syntax and semantics of programming languages, grammars, design of programming languages, data types, variables, expressions and statements, procedures, recursion, parameter passing, dynamic and static memory management. Functional, logic, and object-oriented programming paradigms. Examples from typical and modern programming languages.

**Course Objectives**

The objectives of this course are to develop a basic understanding of programming concepts and using these programming concepts in C++/C# languages. Structured programming concept is introduced. Programming constructs such as sequential structures, selection structures, and repetition structures are explained. As for introduction to programming with C++/C# languages, variables, if-then-else, loop structures: for/while/do-while, break/continue/switch statements, flowcharting solutions, arrays are covered.

**Course Content**

- Data types review
- Functions, control structures, loops, if-else, switch-case
- Object Oriented Paradigm
- Recursion
- Exception handling, defining custom exceptions
- Using libraries, Math, Algorithm libraries
- Strings and Regular expressions

- Midterm Exam
- XML, JSON
- Serialization
- Threads
- Design Patterns
- Working with database
- Advanced Patterns
- Project presentations

**Teaching Methods**

- Interactive lectures
- Tutorial

**Assessment Methods**

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</table>

**Total Workload:** 129

**Learning Outcomes**

After completion of this course, students should be able to:

1. Select an appropriate programming language for solving a computational problem, with justification.
2. Compare programming languages.
3. Express computational solutions in several of the main programming languages.
4. Evaluate the name, data, and control structures as well as the syntax of a programming language with respect to those principles.
5. Implement simple programs.

**Prerequisite Course(s)**

Programming I

**Language of Instruction**

English

**Mandatory Literature**

- Robert W. Sebesta, Concepts of Programming Languages, 9E, Addison-Wesley, 2009

**Recommended Literature**


**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

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**Total Workload: 129**

**ECTS Credit (Total Workload / 25): 5**
# Course: UNSTRUCTURED DATA

**Course Code:** CEN 340  
**Course Name:** UNSTRUCTURED DATA  
**Level:** Undergraduate  
**Year:** III  
**Semester:** VI  
**ECTS Credits:** 5  
**Status:** Elective  
**Hours/Week:** 3+2  
**Total Hours:** 45+30

## Course Description
This course features an introduction to big data based on unstructured data approach.

## Course Objectives
Objective of the course is to introduce students to the fundamental concepts of unstructured data with a solid understanding of big data usage, storage and analysis.

## Course Content
- Structured vs unstructured data
- Dealing with heterogeneous data
- Data transformation & feature generation (1)
- Data transformation & feature generation (2)
- Basic Machine Learning (1)
- Basic Machine Learning (2)
- Information Visualization background
- Midterm Exam
- Uncertainty
- Web Analytics (1)
- Web Analytics (2)
- Crowd Sourcing (1)
- Crowd Sourcing (2)
- Current research in information driven interfaces
- Project presentation

## Teaching Methods
- Interactive lectures
- Tutorial
- Presentations
- Laboratory Practice

## Assessment Methods

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<th>Quiz</th>
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<th>Project</th>
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## Learning Outcomes
After completion of this course, students should be able to:
1. Learn fundamental concepts of unstructured data
2. Collect data from web, various APIs from various data formats
3. Analyze and visualize huge amounts of heterogeneous data
4. Convert data formats between structured – unstructured and vice versa
5. Learn how to use appropriate tools

## Prerequisite Course(s)
- 

## Language of Instruction
English

## Mandatory Literature
- Big Data Fundamentals: Concepts, Drivers & Techniques (The Prentice Hall Service Technology Series from Thomas Erl)  

## Recommended Literature
- Next Generation Databases: NoSQLand Big Data 1st ed. 2015 Edition by Guy Harrison

## ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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**ECTS Credit (Total Workload / 25):** 5
### Course Description
This course covers professional communications, social context of computing, teamwork concepts and issues, intellectual properties, legal issues in computing, organization context, professional and ethical issues, responsibilities, privacy and civil liberties, and other topics.

### Course Objectives
Objectives of the course are to give understanding of the role of ethics in the field of information technology, ethical procedures and behaviors in the organization related to information security, ethical concerns of information technology professionals.

### Course Content
- What is Ethics
- System administration
- Audit
- Retention policy
- Email issues
- IT personnel issues
- Issues and analyses and design phase
- Midterm Exam
- Programming issues
- Database issues
- ISP and ethics
- End users
- Mobile devices
- Penetration test
- Project presentation

### Teaching Methods Description
- Interactive lectures
- Tutorial
- Discussions and group works

### Assessment Methods Description (%)
- Quiz: 0 %
- Lab/Practical Exam: 0 %
- Homework: 0 %
- Term Paper: 0 %
- Project: 0 %
- Attendance: 0 %
- Midterm Exam: 20 %
- Class Deliverables: 0 %
- Presentation: 50 %
- Final Exam: 30 %

### Learning Outcomes
After completion of this course, students should be able to:
1. Understand the issues related to privacy and confidentiality as they relate to information technology and specifically how they relate to social networking.
2. Understand the issues related to freedom of expression, intellectual freedom, intellectual property, and copyright law as they relate to electronic publishing.
3. Understand the issues related to ethical standards in software development, specifically in cases where information technology affects health, safety, productivity, and quality of life.
4. Understand the ethical issues associated with gathering, storing and accessing data in databases.

### Prerequisite Course(s)
- 

### Language of Instruction
English

### Mandatory Literature
- Ethics in Information Technology, George Reynolds, 2014

### Recommended Literature
- Ethics for the Information Age (5th Edition), Michael J. Quinn, 2012
- IT Ethics Handbook: Right and Wrong for IT Professionals by Northcutt, Stephen, Madden, Cynthia and Welti, Cynthia, 2004

### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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| ECTS Credit (Total Workload / 25)               | 5        |
Course Code: CEN 342  
Course Name: SOFTWARE QUALITY ASSURANCE

Level: Undergraduate  
Year: III  
Semester: VI  
ECTS Credits: 5

Status: Elective  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description
This course covers study of the basic software quality assurance, types of testing, metrics, creating testing plans, automation.

Course Objectives
Objective of the course is to provide an introduction to the software engineering testing process; describe the quality assurance process and its role in software development.

Course Content
- SQA Concepts: Basic notions: Quality Assurance, Detection vs. Prevention, Verification & Validation, testing
- Testing Concepts: Definition, Types and Levels of testing, Black vs. White Box testing
- Test Techniques: White Box techniques
- Test Techniques: Black Box techniques
- Test Planning: Test Plans
- Test Planning: Test Design Specifications
- Test Planning: Test Cases
- Midterm Exam
- Test Metrics: Pre-process metrics: Estimation
- Test Metrics: In-process metrics: Process Management
- Test Metrics: End-process metrics: Process Improvement
- Test Management: Test planning, resource management
- Test Management: Test reporting, tools
- Test Automation: What and How to automate?
- Project presentation

Teaching Methods Description
- Interactive Lectures
- Tutorials
- Presentations
- Laboratory Practice

Assessment Methods Description (%)
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<th>Assessment Method</th>
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Learning Outcomes
After completion of this course, students should be able to:
1. Apply theory, techniques and relevant tools to the specification, analysis, design, implementation and testing of a simple computing product;
2. Evaluate basic processes and outcomes of computing
3. Undertake intermediate level systems development work using industry recognized tools, technologies and techniques
4. Conduct tests
5. Analyze, design, implement and test products.

Prerequisite Course(s)
-

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
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ECTS Credit (Total Workload / 25) 5
Course Code: CEN 343  
Course Name: SECURE SOFTWARE SYSTEM DEVELOPMENT

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Course Description
This course covers various analysis and design techniques for improving software security, as well as how to use these techniques and tools to improve and verify software designs and security. Finally, course will cover the technical trends affecting software security.

Course Objectives
This course will provide students with a good understanding of the theories and tools used for secure software design, threat analysis, secure coding, and vulnerability analysis. Students will study, in-depth, vulnerability classes to understand how to protect software and how to secure software.

Course Content
- SQL Injection and Cross-Site Scripting
- Request Forgery and Clickjacking
- "Think Like a Thief" Day
- Threat Modelling
- Cryptography
- Session Management
- Authentication, Identity and Passwords
- Midterm Exam
- Attacking C Code and Robust C Programming
- Access Control
- Capabilities and Usability
- Social Engineering
- Network Security
- Security in the Cloud
- Mobile Phone Application Security and Security Models

Teaching Methods
- Interactive lectures
- Tutorial

Assessment Methods
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<tr>
<th>Description (%)</th>
<th>Quiz</th>
<th>Lab/Practical Exam</th>
<th>Homework</th>
<th>Term Paper</th>
<th>Project</th>
<th>Attendance</th>
<th>Midterm Exam</th>
<th>Class Deliverables</th>
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Learning Outcomes
After completion of this course, students should be able to:
1. Verify is software designed in secure manner
2. Perform basic hacking attack to developed software (mobile or web)
3. Build model for validating security of software
4. Analyze all elements related to software security (network, cryptography, cloud, ...)
5. Analyze the network for security issues

Prerequisite Course(s)
Programming I

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT'S WORKLOAD)

<table>
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48
Course Code: CEN 344  
Course Name: GAME PROGRAMMING

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### Course Description

This course is introduction to the programming and development of computer/video games, especially through the use of a computer game engine (e.g. Unity, Unreal, etc.), Course will cover the major aspects of programming and creating games within a game engine, including world/level design, programming within a game engine, basic interaction between code and game assets (character, buildings, objects, weapons, camera, etc.), movement and manipulation of game assets, events such as object collisions, triggers, and timed events, common gameplay mechanics, creating a game interface (HUD), non-player characters and AI, multiplayer games and networking, and animation and game sequences.

### Course Objectives

Objective of this course is to train student to build video game for smart phones and be able to implement it in multi-player mode. The course is a project-based course, culminating with the students integrating the many topics and tools to develop their own complete game.

### Course Content

- Introduction to Unity and Game Engines
- Introduction to C# (or JavaScript)
- Unity Scripting and Unity Libraries
- Building Game Worlds / Levels (Scenes) in Unity
- Types of Assets (game objects), and Unity Asset Store
- Modifying and Creating your own Assets and Prefabs
- Adding Components to Assets and Interaction between Assets and Scripts
- Midterm Exam
- The Player Character, Camera Views, and Movement
- Gameplay Mechanics (and Effects) and Physical Challenges
- Objects, Collisions, Collection, and “Power Ups”
- Triggers (location-based events) and Timed Events
- Non-Player Characters and Artificial Intelligence
- Multiplayer Games and Networking
- Creating the Game Interface (HUD) and Animation and Game Sequences

### Teaching Methods Description

- Interactive lectures
- Tutorial

### Assessment Methods Description (%)

<table>
<thead>
<tr>
<th>Assessment Methods</th>
<th>Quiz</th>
<th>Homework</th>
<th>Project</th>
<th>Midterm Exam</th>
<th>Presentation</th>
<th>Lab/Practical Exam</th>
<th>Term Paper</th>
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</table>

### Learning Outcomes

After completion of this course, students should be able to:
1. Describe the basic principles used in game design and development
2. Describe how to best utilize smart phone resources for game development
3. Design game character and scenes
4. Build fully functional game for smart phone
5. Publish the game

### Prerequisite Course(s)

Programming I

### Language of Instruction

English

### Mandatory Literature

- Joe Hocking: Unity in Action Multiplatform Game Development in C# with Unity 5 1st Edition 2015

### Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
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<th>Workload</th>
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<td>Lecture (15 weeks x Lecture hours per week)</td>
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**Total Workload**

124

**ECTS Credit (Total Workload / 25)**

0
Course Code: CEN 345  
Course Name: INFORMATION SECURITY

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<th>Year: III</th>
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</table>

Course Description:
This course provides understanding of the conventional encryption, public key encryption and security itself, basic issues addressed by security capability and practical applications that have been implemented and are in use to provide security.

Course Objectives:
The main objective of this course is to give to students understanding of the concept of information security theoretically and practically which will generally cover: conventional encryption, public key encryption and network security itself. Then, course will discuss access control, security protocols and tools for detecting attacks and defending from them. Finally, course will cover biometric security, human factor in security and crime and digital forensics.

Course Content:
- Introduction to Security
- Midterm Exam
- Cryptography (1)
- Network and System Security
- Cryptography (2)
- Network Attacks and Defends
- Cryptography (3)
- Biometry
- Access control
- Human factor in security
- Security protocols
- IT crime and digital forensics
- Software and Security
- Project presentation

Teaching Methods Description:
- Interactive lectures and communication with students
- Practical Sessions
- Problem solving or case studies
- Exercises

Assessment Methods Description (%):
- Quiz 0 %  
  Lab/Practical Exam 0 %
- Homework 10 %  
  Term Paper 0 %
- Project 20 %  
  Attendance 0 %
- Midterm Exam 30 %  
  Class Deliverables 0 %
- Presentation 0 %  
  Final Exam 40 %

Total 100 %

Learning Outcomes:
After completion of this course, students should be able to:
1. Define confidentiality, integrity and availability
2. Develop some general design decisions that should be made when constructing secure systems
3. Develop basic application of information security concepts
4. Write software that utilizes encryption, hashing and digital signatures
5. Design secure symmetric and asymmetric authentication protocols
6. Explain how boot sectors, buffer overflows and memory leaks can be vulnerable to security attacks

Prerequisite Course(s):

Language of Instruction: English

Mandatory Literature:

Recommended Literature:
- Threat Modelling: Designing for Security 1st Edition by Adam Shostack

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
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<tr>
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Total Workload
131

ECTS Credit (Total Workload / 25)
5
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**Course Description**
Software Engineering: Modelling with UML, introduction to design patterns, project management and software development processes, requirements elicitation and analysis, system design, object design, testing, rational and configuration management, software life cycle, and methodologies. Particular emphasis is on a team project in which a group of students implement a system from its specification.

**Course Objectives**
Objective of this course is to give students understanding of: modelling with UML and design patterns, project management and software development processes, requirements analysis, system design, object design, testing. Students will do a team project in groups to implement a system from its specification.

**Course Content**
- Introduction to Software Engineering
- Modelling with UML (1)
- Modelling with UML (2)
- Introduction to Design Patterns
- Project Organization and Communication
- Requirements Elicitation
- Project evaluation
- Midterm Exam
- Requirements Analysis
- System Design (1)
- System Design (2)
- Object Design
- Mapping Models to Code (1)
- Mapping to Code (2)
- Testing

**Teaching Methods**
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Homework

**Assessment Methods**
-Quiz 0 %
-Homework 30 %
-Project 30 %
-Midterm Exam 20 %
-Presentation 0 %

<table>
<thead>
<tr>
<th>Assessment Methods Description (%)</th>
<th>Quiz</th>
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**Learning Outcomes**
After completion of this course, students should be able to:
1. Capture, document and analyze requirements.
2. Translate a requirements specification into an implementable design, following a structured and organized process.
3. Make effective use of UML, along with design strategies such as defining a software architecture, separation of concerns and design patterns.
4. Formulate a testing strategy for a software system, employing techniques such as unit testing, test driven development and functional testing.
5. Evaluate the quality of the requirements, analysis and design work done during the module.

**Prerequisite Course(s)**
Programming I

**Language of Instruction**
English

**Mandatory Literature**
- Bernd Bruegge, Allen H. Dutoit, Object-Oriented Software Engineering Using UML, Patterns, and Java, Prentice Hall; (3 Edition), 2009

**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
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<tr>
<th>Activities</th>
<th>Quantity</th>
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Total Workload 124

ECTS Credit (Total Workload / 25) 5
**Course Code:** CEN 352  
**Course Name:** INTRODUCTION TO MANAGEMENT INFORMATION SYSTEMS

**Level:** Undergraduate  
**Year:** III  
**Semester:** VI  
**ECTS Credits:** 5

**Course Status:** Elective

**Hours/Week:** 3+2  
**Total Hours:** 45+30

**Course Description**  
Introduction to MIS course explores current information systems concepts and technologies. Students learn how information systems give a business or organization a competitive edge by providing technologies that help managers plan, control, and make decisions. Includes topics such as hardware and software components of an information system, e-business concepts and implementation, and a survey of common information systems used today.

**Course Objectives**  
Objectives of this course are introducing basic concepts of IS and IT and exploring how technology can be used to create business value; examining the potential benefits and limitations of IT and providing an overview of the components of computers; increasing awareness of managerial issues raised by the use of IT; providing a foundation needed for subsequent MIS coursework.

**Course Content**

<table>
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<th>Topic</th>
<th>Description</th>
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<tbody>
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<td>1. Why MIS? Introduction to course</td>
<td>Processes, organizations and IS</td>
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<td>2. The importance of MIS</td>
<td>Social Media IS</td>
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<td>3. Collaboration IS</td>
<td>BI systems</td>
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<td>4. Strategy and IS</td>
<td>Development processes</td>
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<td>5. Hardware, Software and Mobile Systems</td>
<td>IS management</td>
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<td>6. Database Processing</td>
<td>Project presentations</td>
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<td>7. Cloud</td>
<td>Information security management</td>
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<td>8. Midterm Exam</td>
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**Teaching Methods**

- Interactive lectures and communication with students
- Discussions and group work
- Problem solving or case studies
- Exercises

**Assessment Methods**

<table>
<thead>
<tr>
<th>Assessment Type</th>
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</tr>
<tr>
<td>Homework</td>
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</tr>
<tr>
<td>Project</td>
<td>25 %</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>20 %</td>
</tr>
<tr>
<td>Presentation</td>
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</tr>
<tr>
<td>Lab/Practical Exam</td>
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<tr>
<td>Term Paper</td>
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<tr>
<td>Attendance</td>
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<tr>
<td>Class Deliverables</td>
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</tr>
<tr>
<td>Final Exam</td>
<td>40 %</td>
</tr>
</tbody>
</table>

**Learning Outcomes**

After completion of this course, students should be able to:

1. Explain the issues involved in the development and deployment of management information systems.
2. Investigate the opportunities and problems associated with computer-based management information system that will provide the background for determining the usefulness of computers to assist management in the planning and control of business operations.
3. Evaluate IT-enabled organizational systems and contribute to system development efforts.
4. Differentiate between several types of information system.
5. Differentiate between database and data warehouse.

**Prerequisite Course(s)**

- 

**Language of Instruction**

- English

**Mandatory Literature**


**Recommended Literature**


**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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<tbody>
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<tr>
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**Total Workload**

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<tr>
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**Course Code:** CEN 353  
**Course Name:** INTRODUCTION TO E-BUSINESS/E-COMMERCE  
**Level:** Undergraduate  
**Year:** III  
**Semester:** V  
**ECTS Credits:** 5  
**Status:** Elective  
**Hours/Week:** 3+2  
**Total Hours:** 45+30

### Course Description
This course explores how the Internet has revolutionized the buying and selling of goods and services in the marketplace. Topics include: Internet business models, electronic commerce infrastructure, designing online storefronts, payment acceptance and security issues, and the legal and ethical challenges of electronic commerce. Students will also gain hands-on experience in designing a web site using an HTML authoring tool.

### Course Objectives
The objective of this course is to provide an understanding of basic principles of electronic business (e-business) in commercial and non-commercial environments. It examines different models and technologies for e-business that can improve an organization’s effectiveness and competitiveness. It also covers important management issues which surround the application and use of these technologies.

### Course Content

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>Introduction to course</td>
<td>Midterm Exam</td>
</tr>
<tr>
<td>Introduction to electronic commerce</td>
<td>The environment of e-commerce</td>
</tr>
<tr>
<td>Technology infrastructure</td>
<td>Web server hardware and software</td>
</tr>
<tr>
<td>Selling on the Web</td>
<td>E-commerce software</td>
</tr>
<tr>
<td>Marketing on the Web</td>
<td>E-commerce security</td>
</tr>
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<td>B2B activities</td>
<td>Payment systems for e-commerce</td>
</tr>
<tr>
<td>Social networking, mobile commerce and online auctions</td>
<td>Planning for e-commerce</td>
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<tr>
<td></td>
<td>Project presentations</td>
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### Teaching Methods

<table>
<thead>
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<tbody>
<tr>
<td>Interactive lectures and communication with students</td>
<td>Problem solving or case studies</td>
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<tr>
<td>Discussions and group work</td>
<td>Exercises</td>
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### Assessment Methods

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<tr>
<td>Homework</td>
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<tr>
<td>Term Paper</td>
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</tr>
<tr>
<td>Project</td>
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<tr>
<td>Attendance</td>
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<tr>
<td>Midterm Exam</td>
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<td>Class Deliverables</td>
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</table>

**Total:** 100 %

### Learning Outcomes
After completion of this course, students should be able to:

1. Demonstrate an understanding of basic e-business concepts and principles
2. Explain different e-business models and recognize their importance to an organization
3. Select appropriate technologies to support e-business processes
4. Develop a prototype e-business system using a commercial software tool.
5. Explain Web marketing approaches and elements of branding.

### Prerequisite Course(s)
-  
### Language of Instruction
English

### Mandatory Literature

### Recommended Literature
- (Other relevant references will be provided during the semester in relation to specific topics)

### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
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**Total Workload:** 129

**ECTS Credit (Total Workload / 25):** 5
## Course Code: CEN 354  
### Course Name: INTRODUCTION TO DATA MINING

<table>
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<th>Year: III</th>
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### Course Description
The data mining process includes data selection and cleaning, machine learning techniques to "learn" knowledge that is "hidden" in data, and the reporting and visualization of the resulting knowledge. This course will cover these issues and will illustrate the whole process by examples of practical applications from the life sciences, computer science, and commerce. Several machine learning topics including classification, prediction, and clustering will be covered.

### Course Objectives
The objectives of this course are to: introduce to students basic concepts and techniques of Data Mining; help students to develop skills of using recent data mining software for solving practical problems; to help students to gain experience of doing independent study and research.

### Course Content
- Data Preprocessing
- Mining Frequent Patterns
- Associations
- Correlations
- Classification
- Prediction
- Cluster Analysis
- Midterm Exam
- Mining Stream
- Time-Series and Sequence Data
- Graph Mining
- Social Network Analysis
- Multi-Relational Data Mining
- Mining Object
- Spatial, Multimedia, Text and Web Data

### Teaching Methods
- Interactive lectures
- Tutorial
- Project
- Homework

### Assessment Methods

<table>
<thead>
<tr>
<th>Description (%)</th>
<th>Quiz</th>
<th>Lab/Practical Exam</th>
<th>Homework</th>
<th>Term Paper</th>
<th>Project</th>
<th>Attendance</th>
<th>Midterm Exam</th>
<th>Class Deliverables</th>
<th>Presentation</th>
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</tbody>
</table>

After completion of this course, students should be able to:
1. Display a comprehensive understanding of different data mining tasks and the algorithms most appropriate for addressing them.
2. Evaluate models/algorithms with respect to their accuracy.
3. Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques.
4. Critique the results of a data mining exercise.
5. Develop hypotheses based on the analysis of the results obtained and test them.
6. Conceptualize a data mining solution to a practical problem.

### Prerequisite Course(s)
- 

### Language of Instruction
English

### Mandatory Literature
- Data Mining: Concepts and Techniques, by Jiawei Han and Micheline Kamber

### Recommended Literature

### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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</thead>
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| ECTS Credit (Total Workload / 25)                    |          |          | 5        |

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54
### Course Code: CEN 355
### Course Name: SPECIAL TOPICS IN DATABASE SYSTEMS

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<th>Level:</th>
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<tbody>
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<td>Semester:</td>
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</tbody>
</table>

#### Course Description
This course extends fundamentals of database systems like connection to database from high level programming languages, stored procedures, indexing and database optimization. Introduction to NoSQL concepts of databases is part of this course.

#### Course Objectives
Objective of the course is to give understanding of relational database systems, data management and indexing, overview of NoSQL databases and BigData problems and understanding of current NoSQL solutions for them.

#### Course Content
- Recap of Relational Database Concepts, Connecting to DB from high level programming language,
- Stored procedures and triggers (1)
- Stored procedures and triggers (2)
- ORM and persistence frameworks
- Details of database indexes (1)
- Details of database indexes (2)
- Midterm Exam
- Partitioning strategies in RDBMS
- Introduction to NoSQL
- Key Value databases
- Document databases
- Graph databases
- Database scalability
- Preparation for Final Exam

#### Teaching Methods Description
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Exercises

#### Assessment Methods Description (%)
- Quiz 20 %
- Lab/Practical Exam 10 %
- Homework 0 %
- Term Paper 0 %
- Project 20 %
- Attendance 0 %
- Midterm Exam 20 %
- Class Deliverables 0 %
- Presentation 0 %
- Final Exam 30 %

#### Total 100 %

After completion of this course, students should be able to:
1. Design relational database and optimize it for production use.
2. Troubleshoot any relational database issue and find solution for it.
3. Identify size of problem in matter of data and choose adequate database solution.
4. Work with any kind of database system.
5. Choose correct database solution for specific software engineering problem.

#### Prerequisite Course(s)
- 

#### Language of Instruction
- English

#### Mandatory Literature
- Java Persistence with Hibernate - Christian Bauer and Gavin King
- MySQL Stored Procedure Programming - Guy Harrison and Steven Feuerstein

#### Recommended Literature

#### ECTS (ALLOCATED BASED ON STUDENT'S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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**Total Workload** 129

| ECTS Credit (Total Workload / 25) | 5 |
Course Code: CEN 357  
Course Name: STRATEGIC INFORMATION SYSTEM

Level: Undergraduate  
Year: III  
Semester: V  
ECTS Credits: 5

Status: Elective  
Hours/Week: 2+2  
Total Hours: 45+30

Course Description
This course allows students to develop an appreciation of the impact of Enterprise Resource Planning Systems on businesses and to understand the issues involved in the design, implementation and maintenance of these systems. It explores basic methodologies and tools that are used in the implementation of Enterprise Resource Planning Systems.

Course Objectives
Objective of the course is to teach students how to translate business requirement into information systems that support a company’s short- and long-term objectives through class discussion, case studies, hands-on assignments and team project.

Course Content
- Business Process Reengineering
- Competitive advantage through information systems
- Evaluating the success of new IS/IT implementations
- Focus on Electronic Commerce
- Identifying new IS/IT opportunities
- New Technologies
- Planning, implementation and delivery
- Midterm exam
- Realizing the benefits, and managing the change
- Specification of requirements
- Evaluating risk
- Globalisation - impact on business strategies
- Understanding how an organisation functions
- Understanding processes
- Presentations

Teaching Methods
Description
- Interactive lectures
- Tutorial

Assessment Methods
Description (%)
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<thead>
<tr>
<th>Assessment Type</th>
<th>Percentage</th>
<th>Description</th>
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<td>Final Exam</td>
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<tr>
<td>Total</td>
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</tr>
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</table>

Learning Outcomes
After completion of this course, students should be able to:
1. Define concepts of information systems strategy and how to it is aligned with business strategy
2. Evaluate and plan strategic information systems across an organization's various functions
3. Understand the role of future trends in technology and their impact in defining/redefining strategies in an organization to attain and maintain competitive advantage.
4. Measure the return on investment in information systems.
5. Specify requirements for SIS.

Prerequisite Course(s)
- 

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
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</tr>
</thead>
<tbody>
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Total Workload: 125

ECTS Credit (Total Workload / 25): 125

56
Course Code: CEN 358  
Course Name: INTRODUCTION TO COMPUTER VISION  
Level: Undergraduate  
Year: III  
Semester: VI  
ECTS Credits: 5  
Status: Elective  
Hours/Week: 3+2  
Total Hours: 45+30  

Course Description: Image formation, image processing for feature detection, object recognition and representation, motion analysis, simple motion estimation problems, stereo vision, camera models and projections.

Course Objectives: Objective of the course is to teach students fundamentals of computer vision.

Course Content:  
- Introduction  
- Machine learning (1)  
- Machine learning (2)  
- Machine learning (3)  
- Pattern classification (1)  
- Pattern classification (2)  
- Pattern classification (3)  
- Midterm exam  
- Segmentation (1)  
- Segmentation (2)  
- Segmentation (3)  
- Design examples / MATLAB  
- Design examples / MATLAB  
- Design examples / .NET  
- Design examples / .NET

Teaching Methods:  
- Interactive lectures  
- Tutorial

Assessment Methods:  
- Quiz: 10 %  
- Lab/Practical Exam: 0 %  
- Homework: 10 %  
- Term Paper: 0 %  
- Project: 20 %  
- Attendance: 0 %  
- Midterm Exam: 20 %  
- Class Deliverables: 0 %  
- Presentation: 0 %  
- Final Exam: 40 %

Learning Outcomes: After completion of this course, students should be able to:

1. Identify basic concepts, terminology, theories, models and methods in the field of computer vision, image analysis and image processing.
2. Describe known principles of human visual system
3. Develop and systematically test different basic methods of computer vision, image analysis and image processing
4. Experimentally evaluate different image analysis algorithms and summarize the results
5. Choose appropriate image processing methods for image filtering, image restoration, image reconstruction, segmentation, classification and representation.

Prerequisite Course(s): -

Language of Instruction: English


Recommended Literature:

BAD (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
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<tr>
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Total Workload: 125

ECTS Credit (Total Workload / 25): 5
Course Code: CEN 359  
Course Name: INTRODUCTION TO MACHINE LEARNING  
Level: Undergraduate  
Year: III  
Semester: VI  
ECTS Credits: 5

Status: Compulsory  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description
Machine learning has been essential to the success of many recent technologies, including autonomous vehicles, search engines, genomics, automated medical diagnosis, image recognition, and social network analysis, among many others. This course will introduce the fundamental concepts and algorithms that enable computers to learn from experience, with an emphasis on their practical application to real problems. This course will introduce supervised learning, unsupervised learning and reinforcement learning. Additionally, the course will discuss evaluation methodology and recent applications of machine learning, including large scale learning for big data and network analysis.

Course Objectives
The course aims to provide an introduction to the basic principles, techniques, and applications of Machine Learning. Programming assignments are used to help clarify basic concepts. The course covers the principles, design and implementation of learning programs that improve their performance on some set of tasks with experience.

Course Content
- Linear Algebra Review
- Linear Regression (1)
- Linear Regression (2)
- Neural Networks (1)
- Neural Networks (2)
- Support Vector Machines (1)
- Support Vector Machines (2)
- Midterm Exam
- Unsupervised Learning (1)
- Unsupervised Learning (2)
- Recommender System
- Anomaly Detection (1)
- Anomaly Detection (2)
- Large Scale Machine Learning
- Preparation for Final Exam

Teaching Methods
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Exercises

Assessment Methods
- Quiz
- Lab/Practical Exam
- Homework
- Term Paper
- Project
- Attendance
- Midterm Exam
- Class Deliverables
- Presentation
- Final Exam

Learning Outcomes
After completion of this course, students will be able to:
1. Describe machine learning algorithms and apply them in data-driven knowledge discovery and program synthesis.
2. Design and implement several machine learning algorithms.
3. Identify, formulate and solve machine learning problems that arise in practical applications.
4. Describe the strengths and weaknesses of different machine learning algorithms and be able to adapt or combine some of the key elements of existing machine learning algorithms to design new algorithms as needed.
5. Compare modeling aspects of various machine learning approaches.

Prerequisite Course(s)
- 

Language of Instruction
English

Mandatory Literature
- Learning From Data by Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.T. Lin. AML Book

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
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<th>Workload</th>
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Total Workload 129

ECTS Credit (Total Workload / 25) 5
Course Code: CEN 363  
Course Name: INTRODUCTION TO NETWORK PROGRAMMING

Level: Undergraduate  
Year: III  
Semester: VI  
ECTS Credits: 5

Status: Elective  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description
This course will cover the practical aspects of computer network programming, with emphasis on the Internet. The goal of this course is to introduce the students to the basics of computer networks and Internet programming. Course will introduce the students to the TCP/IP protocol stack and some of its important protocols. Students will also be introduced to multi-tier application development and RPC technologies including: RMI, CORBA, JB.

Course Objectives
The objective of this course is to introduce students to programming fundamentals and Java programming.

Course Content
- Basic concepts, protocols and terminology
- Network programming in Java
- Multithreading and multiplexing (1)
- Multithreading and multiplexing (2)
- File handling
- Remote Method Invocation (RMI)
- Common Object Request Broker Architecture (CORBA)
- Midterm Exam
- Java Database Connectivity (JDBC)
- Servlets
- JavaServer Pages (JSPs)
- JavaBeans
- Multimedia
- Applets
- Project presentations

Teaching Methods
- Interactive lectures
- Tutorial
- Project

Assessment Methods

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<th>Lab/Practical Exam</th>
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<td>Project</td>
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<tr>
<td>Presentation</td>
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<td>Final Exam</td>
<td>40 %</td>
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</tbody>
</table>

Total 100 %

Learning Outcomes
After completion of this course, students should be able to:
1. Experiment with protocol analyzers (packet sniffers) to understand and analyze the operation of the different TCP/IP protocols.
2. Write web applications using a combination of client-side (JavaScript, HTML, XML, WML) and server-side technologies (JSP, JSF, SERVLETs).
3. Write network applications using state-of-the-art RPC technologies including: RMI, CORBA, JB.
4. Demonstrate knowledge of programming for network communications.
5. Describe major technologies used in network communications.

Prerequisite Course(s)
Programming I

Language of Instruction
English

Mandatory Literature

Recommended Literature
- David Reilly and Michael Reilly, Java Network Programming and Distributed Computing, Addison-Wesley (ISBN: 0-201-71037-4)

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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Total Workload 125

ECTS Credit (Total Workload / 25) 5

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<tr>
<th>Course Code: CEN 364</th>
<th>Course Name: INTRODUCTION TO NETWORK SECURITY</th>
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<td>Hours/Week: 3+2</td>
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**Course Description**

This course provides understanding of the conventional encryption, public key encryption and hash function and network security itself, basic issues addressed by network security capability and practical applications that have been implemented and are in use to provide network security.

**Course Objectives**

The main objective of this course is to give to students understanding of the concept of network security theoretically and practically which will generally cover 3 parts: conventional encryption, public key encryption and hash function and network security itself. The first 2 parts will discuss the basic issues to be addressed by network security capability. The third part will discuss the practice of network security, practical applications that have been implemented and are in use to provide network security in-depth knowledge.

**Course Content**

- Introduction to Computer and Network Security
- Symmetric Encryption / Confidentiality
- Symmetric Encryption / Confidentiality
- Public-key Cryptography / Authentication
- Key Distribution / User Authentication
- Transport Layer Security
- Midterm Review
- Midterm Exam
- Email Security (1)
- Email Security (2)
- IP Security (1)
- IP Security (2)
- Intruders
- Malicious Software
- Firewalls

**Teaching Methods Description**

- Interactive lectures and communication with students
- Problem solving or case studies
- Practical Sessions
- Exercises

**Assessment Methods Description (%)**

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<thead>
<tr>
<th>Assessment Method</th>
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</table>

**Learning Outcomes**

After completion of this course, students should be able to:
1. Identify some of the factors driving the need for network security.
2. Describe computer and network security concepts.
3. Define confidentiality, integrity and availability
4. Develop some general design decisions that should be made when constructing secure systems
5. Develop basic application of information security concepts.

**Prerequisite Course(s)**

- 

**Language of Instruction**

English

**Mandatory Literature**


**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

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**ECTS Credit (Total Workload / 25)**

5
Course Code: CEN 365  
Course Name: INTRODUCTION TO MOBILE AND WIRELESS NETWORKING

Level: Undergraduate  
Year: III  
Semester: V  
ECTS Credits: 5

Status: Elective  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description
Wireless transmission (physical layer), wireless media access (link layer), telecommunication systems (such as GSM/GPRS, DECT, TETRA, UMTS and IMT-2000), wireless LANs (IEEE 802.11, Bluetooth), mobile network layer (mobile IP, DHCP), mobile transport layer (TCP over wireless), mobile application support and wireless programming.

Course Objectives
Objective of the course is to teach students fundamentals of mobile and wireless networking.

Course Content
- Introduction
- Wireless transmission (physical layer) (1/2)
- Wireless transmission (physical layer) (2/2)
- Wireless media access (link layer) (1/2)
- Wireless media access (link layer) (2/2)
- Wireless telecommunication systems: GSM/GPRS, EDGE, UMTS
- Wireless LANs: IEEE 802.11
- Mobile network layer (mobile IP, DHCP, mobile ad-hoc networks)
- Mobile transport layer (TCP over wireless)
- Mobile application support
- Introduction to wireless programming
- Wireless sensor networks
- Project presentations

Teaching Methods
- Interactive lectures and communication with students
- Problem solving or case studies
- Practical Sessions

Assessment Methods
- Quiz 0 %  
- Homework 0 %  
- Project 30 %  
- Midterm Exam 20 %  
- Presentation 0 %  
- Term Paper 0 %  
- Attendance 0 %  
- Class Deliverables 0 %  
- Final Exam 50 %

Total 100 %

Learning Outcomes
After completion of this course, students should be able to:
1. Develop the concept of systems thinking in the context of mobile and wireless systems
2. Develop knowledge of the interplay of concepts and multiple sub-disciplines in mobile and wireless systems
3. Develop knowledge and experience in mobile interface and applications design, and development techniques and methodologies set in the context of a research project addressing a real-world application
4. Gain knowledge and experience in applying various computation methods and algorithms as a part of software development and simulations
5. Gain experience in evaluating mobile computing applications, computation methods and algorithms through experiments and simulations

Prerequisite Course(s)

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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Total Workload 125

ECTS Credit (Total Workload / 25) 5

61
Course Code: CEN 381  
Course Name: INTRODUCTION TO COMPUTER GRAPHICS  
Level: Undergraduate  
Year: III  
Semester: V  
ECTS Credits: 5  
Status: Elective  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description
Fundamentals of computer graphics programming. Graphics hardware and software standards. 2D geometric primitives and raster images. 3D object representations. Data structures, algorithms, and the graphics pipeline. Graphical user interfaces. Underlying concepts in computer graphics systems, including games, animation, modeling, rendering, and paint systems.

Course Objectives
The course aims to provide an introduction to the basic principles, techniques, and applications of Computer Graphics.

Course Content
- Introduction to Graphics
- Math Review
- Math Review 2
- Intro to OpenGL
- Transformations and Homogeneous Coordinates
- Viewing, Projection and Viewport Transformations
- Scan Conversion and Texture Mapping
- Midterm Exam
- Blending, Lighting and Material Properties
- Curves and Surfaces
- Image Processing
- Meshes and Subdivision
- Mesh review
- Picking
- Ray Casting
- Practical Sessions
- Homework

Teaching Methods Description
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Homework

Assessment Methods Description (%)
- Quiz: 10 %  
- Lab/Practical Exam: 0 %  
- Homework: 10 %  
- Term Paper: 0 %  
- Project: 20 %  
- Attendance: 0 %  
- Midterm Exam: 20 %  
- Class Deliverables: 0 %  
- Presentation: 0 %  
- Final Exam: 40 %

Total 100 %

Learning Outcomes
After completion of this course, students should be able to:
1. Define the theory of 2D and 3D transformations, projection and viewing.
2. Combine relevant sources and synthesize designs.
3. Identify the core concepts of computer graphics.
4. Create interactive computer graphics using OpenGL.
5. Apply knowledge of display systems, image synthesis, shape modeling, and interactive control of 3D computer graphics applications

Prerequisite Course(s)
- 

Language of Instruction
English

Mandatory Literature

Recommended Literature
ECRS (ALLOCATED BASED ON STUDENT'S WORKLOAD)

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Total Workload 125

ECRS Credit (Total Workload / 25) 5
### Course Code: CEN 382  
### Course Name: MICROPROCESSORS AND MICROCOMPUTING

#### Level: Undergraduate  
#### Year: III  
#### Semester: VI  
#### ECTS Credits: 5

#### Status: Elective  
#### Hours/Week: 3+2  
#### Total Hours: 45+30

### Course Description
Introduction of computer and microprocessor architecture, with focus on Altera's Nios-II soft processor. Computer organization, design and synthesis are covered, as well as use of microcontrollers.

### Course Objectives
Student should be able to analyze and synthesize a computer system at a certain level of complexity and to use advantages of a particular architecture, implement assembly programs and assembly code snippets in C code.

### Course Content
- Basic Structure of Computers
- Instruction Set Architecture (1)
- Instruction Set Architecture (2)
- The Altera Nios II Processor
- Basic I/O
- Software
- Basic Processing Unit
- Midterm Exam
- Pipelining
- I/O Organization
- The Memory System (1)
- The Memory System (2)
- Arithmetic (1)
- Arithmetic (2)
- Embedded Systems

### Teaching Methods Description
- Interactive Lectures
- Practical Sessions
- Exercises
- Presentation

#### Assessment Methods Description (%)
- Quiz: 0 %  
- Lab/Practical Exam: 10 %
- Homework: 10 %  
- Term Paper: 0 %
- Project: 0 %  
- Attendance: 0 %
- Midterm Exam: 30 %  
- Class Deliverables: 10 %
- Presentation: 0 %  
- Final Exam: 40 %

#### Total: 100 %

### Learning Outcomes
After completion of this course, students should be able to:
1. Describe the architecture of microprocessors.
2. Define instruction set for a particular microprocessor.
3. Use practically assembly language for Nios-II as well as C for Nios-II.
4. Outline the topics on the hardware, on which programs execute.
5. Define memory hierarchies, I/O interfaces, bus concepts, serial I/O devices, and interrupt control devices.

### Prerequisite Course(s)
- 

### Language of Instruction
- English

### Mandatory Literature

### Recommended Literature
- 

### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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**Total Workload:** 129  
**ECTS Credit (Total Workload / 25):** 5
**Course Code:** CEN 383  
**Course Name:** SIGNAL PROCESSING FOR COMPUTER ENGINEERING  
**Level:** Undergraduate  
**Year:** III  
**Semester:** V  
**ECTS Credits:** 5

**Status:** Elective  
**Hours/Week:** 3+2  
**Total Hours:** 45+30

### Course Description
Introduction to computer and microprocessor architecture, addressing modes. Arithmetic, logic and program control instructions. Programming microprocessor, 8086/8088 hardware specifications, interrupts, memory and basic I/O interface.

### Course Objectives
Objective of the course is to introduce to students fundamentals of signal processing.

### Course Content
- Introduction to Signals and Systems
- Time Domain Representation of Linear Time-Invariant Systems
- Continuous-Time System Analysis Using the Laplace Transform
- Discrete-Time System Analysis Using the Z-Transform
- Midterm exam
- Fourier Representations for Signals and Applications of Fourier Representations
- Fourier Representations for Signals and Applications of Fourier Representations
- Analog and Digital Filters and Design of Filters
- Analog and Digital Filters and Design of Filters
- Application of Filters
- Application of Filters
- Project presentations

### Teaching Methods Description
- Interactive Lectures
- Practical Sessions
- Exercises
- Presentation

### Assessment Methods Description (%)
- Quiz 10 %  
- Lab/Practical Exam 0 %
- Homework 10 %  
- Term Paper 0 %
- Project 20 %  
- Attendance 0 %
- Midterm Exam 20 %  
- Class Deliverables 0 %
- Presentation 0 %  
- Final Exam 40 %

**Total** 100 %

### Learning Outcomes
After completion of this course, students should be able to:

1. Analyze and implement digital signal processing systems in time domain.
2. Compute the Fourier series and the discrete time Fourier transform (DTFT) of discrete-time signals.
3. Analyze digital signal processing systems using Z-transform and the DTFT.
5. Design digital filters using windows.
6. Sample and reconstruct analog signals.

### Prerequisite Course(s)
- 

### Language of Instruction
English

### Mandatory Literature

### Recommended Literature

### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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**Total Workload** 129

**ECTS Credit (Total Workload / 25)** 5
Course Code: CEN 384
Course Name: COMPUTER ARCHITECTURE
Level: Undergraduate
Year: III
Semester: VI
ECTS Credits: 5
Status: Elective
Hours/Week: 3+2
Total Hours: 45+30

Course Description
Reduced Instruction Set Computer (RISC) architecture, pipelined processor design (instruction and arithmetic pipelines), multiprocessor and alternative architectures, dynamic and static interconnection networks, shared memory multiprocessor systems, message passing multiprocessor systems and parallel processing.

Course Objectives
Objective of the course is to introduce fundamentals of computer architecture to students.

Course Content
- The General Purpose Machine
- Machines
- Machine Languages
- Digital Logic
- Some Real Machines
- Processor Design
- Processor Design—Advanced Topics
- Midterm exam
- Computer Arithmetic
- Arithmetic Unit
- Memory System Design
- Memory System Design
- Input and Output
- Peripheral Devices
- Project presentations

Teaching Methods
- Interactive Lectures
- Practical Sessions
- Exercises
- Presentation

Assessment Methods
- Quiz: 10%
- Lab/Practical Exam: 0%
- Homework: 10%
- Term Paper: 0%
- Project: 20%
- Attendance: 0%
- Midterm Exam: 20%
- Class Deliverables: 0%
- Presentation: 0%
- Final Exam: 40%

Total: 100%

Learning Outcomes
After completion of this course, students should be able to:
1. Develop simple circuits from logic formulae
2. Use logic gates to build components of a simple computer
3. Explain how the various parts of a modern computer function and cooperate
4. Exploit the advantages of an advanced computer memory having virtual memory and cache
5. Program in x86 machine language and assembly code
6. Develop extremely fast programs using a high-level programming language like C combined with assembly code

Prerequisite Course(s)

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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<th>Workload</th>
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Total Workload: 129

ECTS Credit (Total Workload / 25): 5
**Course Code:** CEN 385  
**Course Name:** INTRODUCTION TO CRYPTOGRAPHY

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**Course Description**
This course features a rigorous introduction to modern cryptography, with an emphasis on the fundamental cryptographic primitives of public-key encryption, digital signatures, pseudo-random number generation, and basic protocols and their computational complexity requirements.

**Course Objectives**
The main objective is to introduce core cryptographic tools, and cryptographic reasoning. Through the lens of cryptography, students will also develop, in general, the capability of critical thinking and reasoning of complex systems. Moreover, the objective of the course is to make students familiar with techniques and some of the foundations of cryptography methods. In particular students will be confronted with a range of security objectives, different levels of security that can be achieved and some available cryptographic techniques that can be used.

**Course Content**
- Classical and Public-key Cryptosystems
- Basic Number Theory and Abstract Algebra
- RSA cryptosystem
- Data Encryption Standard
- Advanced Encryption Standard
- Hash Functions (1)
- Hash Functions (2)
- Midterm Exam
- Digital Signatures (1)
- Digital Signatures (2)
- Secret Sharing Schemes
- Zero Knowledge Techniques
- Key Establishment Protocols
- Computational Complexity Requirements
- Preparation for Final Exam

**Teaching Methods**
- Interactive lectures
- Tutorial
- Group Study

**Assessment Methods**

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<tr>
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**Learning Outcomes**
After completion of this course, students should be able to:
1. Describe the difference between symmetric key cryptosystems and public key cryptosystems.
2. Demonstrate an understanding of the relationship between computational complexity and cryptography.
3. Explain the role of mathematics in cryptography.
4. Implement certain cryptosystems.
5. Communicate the significance of cryptography to a general audience.

**Prerequisite Course(s)**
- 

**Language of Instruction**
English

**Mandatory Literature**

**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
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**Total Workload**
130

| ECTS Credit (Total Workload / 25) | 5 |
Course Code: CEN 390  
Course Name: INTRODUCTION TO ARTIFICIAL INTELLIGENCE  
Level: Undergraduate  
Year: III  
Semester: VI  
ECTS Credits: 5  
Status: Elective  
Hours/Week: 3+2  
Total Hours: 45+30  

Course Description
This course introduces representations, techniques, and architectures used to build applied systems and to account for intelligence from a computational point of view. This course also explores applications of rule chaining, heuristic search, logic, constraint propagation, constrained search, and other problem-solving paradigms. In addition, it covers applications of decision trees, neural nets, SVMs and other learning paradigms.

The objectives of this course are to: develop the student's understanding of the issues involved in trying to define and simulate intelligence; familiarize the student with specific, well known Artificial Intelligence methods, algorithms and results; provide the student additional experience in the analysis and evaluation of complicated systems; provide the student with paper and proposal writing experience.

Course Objectives
- Search Algorithms
- Graph Search
- Constraint Satisfaction
- Games
- Machine Learning
- Nearest Neighbors
- Decision Trees
- Midterm Exam
- Neural Networks
- SVM
- Knowledge Representation and Inference (5 weeks)
- Propositional and First Order Logic
- Rule-based Systems
- Natural Language
- Preparation for Final Exam

Course Content
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Homework

Assessment Methods Description (%)

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Learning Outcomes
After completion of this course, students should be able to:
1. Identify problems that are amenable to solution by AI methods, and which AI methods may be suited to solving a given problem.
2. Formalize a given problem in the language/framework of different AI methods.
3. Implement basic AI algorithms.
4. Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports.
5. Apply the skills and techniques in machine learning, such as decision tree induction, artificial neural networks, and genetic algorithm.

Prerequisite Course(s)
- 

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)
Course Code: CEN 391  
Course Name: INTRODUCTION TO NEURAL NETWORKS

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<th>Level: Undergraduate</th>
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**Status:** Elective  
**Hours/Week:** 3+2  
**Total Hours:** 45+30

**Course Description:** This course explores the organization of synaptic connectivity as the basis of neural computation and learning. Perceptrons and dynamical theories of recurrent networks including amplifiers, attractors, and hybrid computation are covered. Additional topics include backpropagation and Hebbian learning, as well as models of perception, motor control, memory, and neural development.

**Course Objectives:** Objective of this course is to teach students fundamentals of neural networks.

**Course Content:**
- Perceptrons: Simple and Multilayer,
- Perceptrons as Models of Vision
- Linear Networks
- Hamiltonian Dynamics
- Antisymmetric Networks
- Excitatory-Inhibitory Networks Learning
- Integrators
- Midterm Exam
- Multistability
- Clustering
- VQ, PCA
- Delta Rule
- Backpropagation
- Stochastic Gradient Descent
- Reinforcement Learning

**Teaching Methods Description:**
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Homework

**Assessment Methods Description (%):**
- Quiz 10 %
- Lab/Practical Exam 0 %
- Homework 10 %
- Term Paper 0 %
- Project 20 %
- Attendance 0 %
- Midterm Exam 20 %
- Class Deliverables 0 %
- Presentation 0 %
- Final Exam 40 %

**Total 100 %**

**Learning Outcomes:**
- Describe the relation between real brains and simple artificial neural network models.
- Explain and contrast the most common architectures and learning algorithms for MultiLayer Perceptrons, Radial-Basis Function Networks, Committee Machines, and Kohonen Self-Organising Maps.
- Discuss the main factors involved in achieving good learning and generalization performance in neural network systems.
- Identify the main implementational issues for common neural network systems.
- Evaluate the practical considerations in applying neural networks to real classification and regression problems.

**Prerequisite Course(s):**

**Language of Instruction:** English

**Mandatory Literature:**

**Recommended Literature:**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD):**

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**Total Workload:** 125

**ECTS Credit (Total Workload / 25):** 0
Course Code: CEN 393  
Course Name: INTRODUCTION TO EVOLUTIONARY COMPUTING

Level: Undergraduate  
Year: III  
Semester: V  
ECTS Credits: 5

Status: Elective  
Hours/Week: 3+2  
Total Hours: 45+30

Course Description
The course provides basic knowledge of biologically inspired methods in computer science, such as genetic algorithms, genetic programming, and artificial life. These methods are both relevant to technical applications, for example, in optimization and design of autonomous systems, and for understanding biological systems, e.g., through simulation of evolutionary processes.

Course Objectives
Objective of the course is to teach students fundamentals of evolutionary computing.

Course Content
- Biological evolution: Introduction and basic properties
- Fundamentals of genetic algorithms: Representations, genetic operators, selection mechanisms
- Theory of genetic algorithms: The schema theorem and the onemax problem
- Different versions of evolutionary algorithms
- Genetic algorithms
- Computer program development (using Matlab) for evolutionary algorithms
- Experiment design
- Boltzmann selection, messy encoding schemes
- Midterm Exam
- Variable-structure encoding schemes
- Diffusion models, subpopulation-based evolutionary algorithms
- Applications of evolutionary algorithms: Function optimization
- Data mining,
- Evolving neural networks, scheduling, the traveling salesman problem,
- Interactive evolutionary algorithms

Teaching Methods
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Homework

Assessment Methods
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Learning Outcomes
After completion of this course, students should be able to:
1. Develop knowledge of evolutionary computation techniques and methodologies set in the context of modern heuristic methods.  
2. Gain experience in matching various evolutionary computation methods and algorithms for particular classes of problems.  
3. Gain experience in applying various evolutionary computation methods and algorithms as a part of software development.  
4. Develop knowledge and experience in developing evolutionary algorithms for real-world applications.  
5. Read and understand scientific research papers and present them in a seminar talk.

Prerequisite Course(s)
- 

Language of Instruction
English

Mandatory Literature

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
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ECTS Credit (Total Workload / 25)
5
**Course Code:** CEN 394  
**Course Name:** INTRODUCTION TO PATTERN RECOGNITION

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**Status:** Elective  
**Hours/Week:** 3+2  
**Total Hours:** 45+30

**Course Description**
This class deals with the fundamentals of characterizing and recognizing patterns and features of interest in numerical data. We discuss the basic tools and theory for signal understanding problems with applications to user modeling, affect recognition, speech recognition and understanding, computer vision, physiological analysis, and more. We also cover decision theory, statistical classification, maximum likelihood and Bayesian estimation, nonparametric methods, unsupervised learning and clustering. Additional topics on machine and human learning from active research are also talked about in the class.

**Course Objectives**
This course’s objective is to teach students fundamentals of pattern recognition.

**Course Content**
- Introduction to Pattern Recognition, Feature Detection, Classification
- Random Vectors, Expectation, Correlation, Covariance
- Decision Theory, ROC Curves, Likelihood Ratio Test
- Training Methods, Maximum Likelihood and Bayesian Parameter Estimation
- Linear Discriminant/Perceptron Learning, Optimization by Gradient Descent
- Support Vector Machines
- K-Nearest-Neighbor Classification
- Midterm Exam
- Unsupervised Learning, Clustering, Vector Quantization, K-means
- Mixture Modeling, Expectation-Maximization
- Hidden Markov Models, Viterbi Algorithm,
- Bayesian Networks
- Decision Trees, Multi-layer Perceptrons
- Reinforcement Learning with Human Interaction
- Genetic Algorithms

**Teaching Methods**
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Homework

**Assessment Methods**

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**Learning Outcomes**
After completion of this course, students should be able to:
1. Formulate and describe various applications in pattern recognition
2. Mathematically derive, construct, and utilize Bayesian-based classifiers, and non-Bayesian classifiers both theoretically and practically.
3. Identify the strengths and weaknesses of different types of classifiers
4. Validate and assess different clustering techniques
5. Apply various dimensionality reduction methods whether through feature selection or feature extraction

**Prerequisite Course(s)**
- 

**Language of Instruction**
English

**Mandatory Literature**
- Introduction to Pattern Recognition: Statistical, Structural, Neural and Fuzzy Logic Approaches by Menahem Friedman, Abraham Kandel, World Scientific Publishing Company.

**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

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**ECTS Credit (Total Workload / 25)**

5
**Course Code:** CEN 396  
**Course Name:** DIGITAL DATA COMMUNICATION  

**Level:** Undergraduate  
**Year:** III  
**Semester:** VI  
**ECTS Credits:** 5  

**Status:** Elective  
**Hours/Week:** 3+2  
**Total Hours:** 45+30

**Course Description**
This is a first class on the fundamentals of data communication networks, their architecture, principles of operations, and performance analyses. One goal will be to give some insight into the rationale of why networks are structured the way they are today and to understand the issues facing the designers of next-generation data networks. Much of the class will focus on network algorithms and their performance.

**Course Objectives**
The course will 1) model and study the effects of channel impairments such as noise and distortion, on the performance of communication systems; 2) introduce signal processing, modulation, and coding techniques that are used in digital communication systems.

**Course Content**
- Digital communication
- Digital transmission
- Optical fiber communication
- Mobile telephone service
- Data encoding (1)
- Data encoding (2)
- Congestion control in networks (1)
- Midterm Exam
- Congestion control in networks (2)
- Data link control (1)
- Data link control (2)
- Circuit switching (1)
- Circuit switching (2)
- ATM and frame relay (1)
- ATM and frame relay (2)

**Teaching Methods Description**
- Interactive lectures and communication with students
- Discussions and group work
- Practical Sessions
- Homework

**Assessment Methods Description (%)**

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<tr>
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<th>Percentage</th>
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<tr>
<td>Presentation</td>
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**Total** 100%

**Learning Outcomes**
After completion of this course, students should be able to:
1. Demonstrate understanding of the fundamental concepts of data communications.
2. Demonstrate understand the basic concepts of LAN and WAN technologies and topologies.
3. Demonstrate understanding of the elements of a protocol, and the concept of layering.
4. Recognize the importance of networking standards, and their regulatory committees.
5. Develop understanding of the seven layers of the OSI model.

**Prerequisite Course(s)**

**Language of Instruction**
English

**Mandatory Literature**

**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

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<th>Activities</th>
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**Total Workload** 125

**ECTS Credit (Total Workload / 25)** 5
Course Code: EEE 394
Course Name: EMBEDDED SYSTEMS

Level: Undergraduate
Year: III
Semester: VI
ECTS Credits: 5

Status: Elective
Hours/Week: 3+2
Total Hours: 45+30

Course Description:
This is practically-orientated and advanced course in the area of electronics design and applications. It is distinctive in that it provides a strong digital technology core backed up with applications-led modules. Examples of these applications include medical and electronics, e-health, intelligent building design, automotive electronics, retail and commerce.

Course Objectives:
The objective of this course is to teach the basic issues related to embedded systems and to show application of embedded systems including medical and electronics, e-health, intelligent building design, automotive electronics, retail and commerce.

Course Content:
- Embedded Microcontrollers: Choosing and using microcontrollers for embedded system design.
- The AT89C51ED2 series microcontrollers.
- Development environments for embedded software.
- Actuators and interfacing: Pulse Width Modulation (PWM).
- Midterm Exam
- Basic control theory: Principles of feedback, logic control and finite state machines.
- Software architectures for implementing controllers.
- Single vs. multitasking. Semaphores. Real time computation.
- Designing distributed applications.
- Project presentations

Teaching Methods Description:
- Interactive Lectures
- Tutorials
- Presentations
- Laboratory Practice

Assessment Methods Description (%):
- Quiz 10 % Lab/Practical Exam 0 %
- Homework 10 % Term Paper 0 %
- Project 20 % Attendance 0 %
- Midterm Exam 20 % Class Deliverables 0 %
- Presentation 0 % Final Exam 40 %
Total 100 %

Learning Outcomes:
After completion of this course, students should be able to:
1. Implement combinatorial logic and sequential systems in terms of basic digital building blocks using simulation software.
2. Design, test and critically evaluate embedded solutions to real world situations using digital components (sequential and combinational).
3. Recognize the key features of embedded systems in terms of computer hardware and be able to discuss their functions.
4. Develop software systems for embedded devices using assembler code.
5. Design, test and critically evaluate embedded solutions to real world situations using (embedded) computer systems interfaced to digital hardware.

Prerequisite Course(s):

Language of Instruction: English

Mandatory Literature:

Recommended Literature:
- Programming and Interfacing the 8051, S.Yeralan, A. Ahluwalia, 1995 Addison Wesley

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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<th>Activities</th>
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72
Course Code: BOS 101  
Course Name: BOSNIAN/CROATIAN/SERBIAN LANGUAGE I

Level: Undergraduate  
Year: I  
Semester: I  
ECTS Credits: 2

Status: Elective  
Hours/Week: 0+2  
Total Hours: 0+ 30

Course Description
Highly personalized course designed to improve knowledge of Bosnian language and communication and language skills. The purpose of this course is to teach Bosnian language basics at the beginner level.

Course Objectives
The objective is to achieve the level of language that would create confidence to communicate in Bosnian with clients, suppliers and colleagues.

Course Content
- Learn how to say „Hello“ and acquaint
- The classes of nouns (muški, ženski, srednji rod)
- Personal pronouns (in the first case), introducing oneself.
- Present tense of verb to be
- Learning some of names of different jobs and male and female form for that kind of nouns
- Terminology about the faculty, exercise with cross-words; numbers 1-10
- Plural
- Midterm Exam
- Numbers 11-10.000; speaking exercise about numbers by phone number, prices
- Demonstrative pronouns
- Introducing the collocations about the speaker's attitude; declarative, interrogative and exclamatory sentences
- Place and sort of accent in Bosnian words; filling out the forms with basic information
- Introducing the question-word; ordinal numbers and classes of adjectives
- Answering on questions What date is...? When it happened?
- SVO order in Bosnian language

Teaching Methods
- Interactive lectures and communications with students
- Discussions and group works
- Presentations

Assessment Methods
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<thead>
<tr>
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<th>Quiz</th>
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</tbody>
</table>

Total 100 %

Learning Outcomes
After completion of this course, students should be able to:
1. Speak Bosnian with confidence
2. Interact more confidently when visiting a Bosnian-speaking region or dealing with Bosnian speakers.
3. Build rapport and strengthen relationships with Bosnian-speaking colleagues and clients through a show of interest in the Bosnian language and culture.
4. Demonstrate goodwill and facilitate international communication at both a personal and organizational level.
5. Differentiate greetings in Bosnian language.

Prerequisite Course(s)

Language of Instruction
- Bosnian and English

Mandatory Literature
- Zenaida Karavdić, Bosnian language as a foreign language, IBU, Sarajevo 2010.
- Hrvatski za početnike 1, Udžbenik hrvatskog kao drugog stranog jezika, Zagreb 2006.

Recommended Literature
- Ronelle Alexander, Ellen Elias-Bursac Bosnian, Croatian, Serbian, a Textbook: With Exercises and Basic Grammar, University of Wisconsin Press, 2006

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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<th>Workload</th>
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Total Workload 50

ECTS Credit (Total Workload / 25) 2
Course Code: TDE 101  
Course Name: TURKISH LANGUAGE I
Level: Undergraduate  
Year: 1  
Semester: 1  
ECTS Credits: 2
Status: Elective  
Hours/Week: 0+2  
Total Hours: 0+30

Course Description
Öğrenciler, Türk dili ve kültürü hakkında bilgi sahibi olur. Dili basit seviyede konuşur, yazar ve okur. Öğrencilerde Türk diline ve kültüre karşı bir düşüncede meydana gelir.

Course Objectives
Türk diliini basit seviyede okuyup, yazma ve konuşma becerisi kazanmak.

Course Content
- Selamlaşma ve Tanışma
- Okul
- Günler Dersler
- Ev
- Ülkeler
- Akrabalar
- Meslekler
- Midterm Exam

- Zaman
- Meyveler Sebzeler
- Yiyecekler İçeceler
- Yemekler
- Gıyeceler
- Konuların Tekrar Edilmesi
- Final Sınavı Preparation

Teaching Methods
- Uygulamalı ders
- Alıştırmalar
- Soru-Cevap
- Tartışma

Assessment Methods
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Learning Outcomes
- After completion of this course, students should be able to:
  1. Türkçe yazma, konuşma ve okuma becerisini kazanır.
  2. Kendini Türkçe tanır.
  3. Ailesinden Türkçe bahsedebilir
  4. Eyüplerin Türkçe karşılığını söyleyebilir.
  5. Dersler, günler ve ay isimlerini öğrenir.
  7. Pazar alışverişinde kullanılan terimlerin Türkçe karşılığını bilir.
  8. Yiyecek ve içeceklerin Türkçe karşılığını bilir.

Prerequisite Course(s)
-

Language of Instruction
Turkish

Mandatory Literature
- Lale Türkçe Kitabı Cilt 1
- Lale Türkçe Çalışma Kitabı 1

Recommended Literature
- Hitit I Türkçe Kitabı

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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ECTS Credit (Total Workload / 25) | 2
Course Code: GRM 101  
Course Name: GERMAN LANGUAGE I

Level: Undergraduate  
Year: I  
Semester: 1  
ECTS Credits: 2

Status: Elective  
Hours/Week: 0+2  
Total Hours: 0+30

Course Description
German language I course is organized in a way that it covers basic communication; structures and vocabulary necessary to comprehend simple daily conversational dialogues and reading texts, and to engage in daily simple communication; information about the culture of the German language.

Course Objectives
The course will enable participants to speak and understand the German language within one semester. Participants will develop effective conversation skills to undertake the language content with confidence. The course will also provide participants with an insight into the culture, customs, traditions and practices of the country.

Course Content
- **Lektion 1 - Guten Tag. Mein Name ist...; Alphabet**  
  - Midterm exam
  - Grammatik – definier Artikel; lokale Adverbien
- **Lektion 2 – Familie und Freunde; Zahlen; interview – Fragen zur Person**  
  - Lektion 5 – Mein Tag
  - Grammatik – trennbare Verben; verbposition
- **Lektion 3 – Essen und Trinken**  
  - Lektion 6 – Freizeit
  - Grammatik – Akkusativ; Ja-/Nein- Frage und Antwort
- **Lektion 4 – Meine Wohnung**  
  - Lektion 7 – ein Leben lang
  - Grammatik – Modalverben; Satzklammer; Perfekt

Teaching Methods
- Interactive lectures and communications with students
- Discussions and group works
- Presentations (at least 1 per student per semester)

Assessment Methods

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Learning Outcomes
After completion of this course, students should be able to:
1. Demonstrate the confidence and listening/speaking skills necessary to participate successfully in spontaneous aural/oral exchanges with native speakers of those particular languages in a variety of personal, professional, and/or academic settings.
2. Demonstrate reading comprehension of foreign language texts intended for developmental (or higher level) foreign language courses.
3. Respond appropriately to written or spoken foreign language by writing paragraphs or short essays that communicate ideas clearly.

Prerequisite Course(s)

Language of Instruction
- Bosnian and German

Mandatory Literature
- Schritte plus 1 – Kursbuch Daniela Niebsch, Franz Specht, Sylvette Penning-Hiemstra

Recommended Literature

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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ECTS Credit (Total Workload / 25) 2

75
**Course Code:** BOS 102  
**Course Name:** BOSNIAN/CROATIAN/SERBIAN LANGUAGE II  
**Level:** Undergraduate  
**Year:** I  
**Semester:** II  
**ECTS Credits:** 2

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**Course Description**  
The Bosnian course adopts a multi-level methodology that integrates the skills of reading, writing, listening, grammar, vocabulary and conversation. These skills are reinforced at all levels and Bosnian is the only teaching language used in the class, except when it is necessary to facilitate the explanation of a grammar rule or lexical phrase to a beginner.

**Course Objectives**  
The Bosnian Course seeks to develop in the students the basic linguistic skills, analytical skills, and cultural and literary knowledge which will enable them to appreciate the uniqueness of other cultures and to function in Bosnian speaking communities.

**Course Content**
- Three ways of forming present tense in Bosnian language  
- Making simple sentences with verb in present tense  
- Collocations to express doubt, uncertainty or ignorance  
- Collocations to ask about the way and where to find something; adverbs left, right, straight, back  
- Genitive and its use (with prepositions iz, od, do)  
- Collocations about the Post office and Bank  
- Accusative and its use (object in sentence, with prepositions za, na)  
- Midterm Exam  
- Collocations about the weather; formal/informal communications  
- Present tense of verb to have  
- Conversation in restaurant; meeting with Bosnian meals and names for different kind of food  
- Present tense of verb to have  
- Present tense and use of verbs to buy, to sit, to tell; future tense compared with present tense  
- Conversation in clothing store; imperative  
- Comparison of adjectives, phonetic rule jotovanje; Conversation about health and parts of body

**Teaching Methods Description**
- Interactive lectures  
- Discussions and group work

**Assessment Methods Description (%)**
- Quiz: 0 %  
- Lab/Practical Exam: 0 %  
- Homework: 20 %  
- Term Paper: 0 %  
- Project: 0 %  
- Attendance: 0 %  
- Midterm Exam: 30 %  
- Class Deliverables: 0 %  
- Presentation: 0 %  
- Final Exam: 50 %

**Total Workload**
- Total: 50

**Learning Outcomes**
After completion of this course, students should be able to:
1. Recognize words in Bosnian language.
2. Communicate in basic Bosnian language.
3. Appreciate and know a little about Bosnian culture.
4. Differentiate colours in Bosnian language.
5. Compare adjectives.

**Prerequisite Course(s):**

**Language of Instruction**
Bosnian and English

**Mandatory Literature**
- Zenaida Karavdić, Bosnian language as a foreign language, IBU, Sarajevo 2010.  

**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
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<td>Seminar / Presentation</td>
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**Total Workload**
- 50

**ECTS Credit (Total Workload / 25)**
- 2
Course Code: TDE 102  
Course Name: TURKISH LANGUAGE II

Level: Undergraduate  
Year: I  
Semester: II  
ECTS Credits: 2

Status: Elective  
Hours/Week: 0+2  
Total Hours: 0+30

Course Description
Öğrenciler, Türk dili ve kültürü hakkında bilgi sahibi olur. Dili basit seviyede konuşur, yazar ve okur. Öğrencilerde Türk diline ve kültüre karşı bir düşüncede meydana gelir.

Course Objectives
Öğrencilere Türkçe'nin temel konularını öğretmek. Dönemin sonunda öğrencileri ifade edebilecek ve Türkçe diyalog kurabilecek seviyeye getirmektedir. Öğrenci Türkiye'de restoran, alışverişe, hastaneye vb. yerlere gittiğinde zorlanmadan insanlarla diyalog kurabilmesini sağlarken.

Course Content
● Etkinlikler  
● Portreler ve Fiziki Özellikler  
● İklim  
● Mekânlar  
●resses  
● Hayvanlar  
● Midterm Exam

Teaching Methods Description
● Uygulamalı ders  
● Alıştırmalar

Assessment Methods Description (%)
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<th>Homework</th>
<th>Term Paper</th>
<th>Project</th>
<th>Attendance</th>
<th>Midterm Exam</th>
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</tbody>
</table>

Learning Outcomes
After completion of this course, students should be able to:
1. Türkçe yazma, konuşma ve okuma becerisini kazanır.
2. Kendini Türkçe tanıtır.
3. Ailesinden Türkçe bahsedebilir.
4. Eşyalarını Türkçe karşılığını söyleyebilir.
5. Dersler, günler ve ay isimlerini öğrenir.
7. Pazar alışverişinde kullanılan terimlerin Türkçe karşılığını bilir.
8. Yiyecek ve içeceklerin Türkçe isimlerini bilir.

Prerequisite Course(s)
-

Language of Instruction
Turkish

Mandatory Literature
● Lale Türkçe Kitabı Cilt 2
● Lale Türkçe Çalışma Kitabı 2

Recommended Literature
● Hitit-II Türkçe Kitabı

ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

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| ECTS Credit (Total Workload / 25)             |          |          | **2**    |
**Course Code:** GRM 102  
**Course Name:** GERMAN LANGUAGE II

<table>
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**Course Description**
This is a continuation of German I course. Interactive communication; grammatical structures and vocabulary commonly used in newspapers, magazines, extended dialogues, readings texts, and short stories; information about the culture of the target language through authentic materials.

**Course Objectives**
These courses emphasize the use of the target language for active communication. They have the following objectives: the comprehension of formal and informal spoken language; the acquisition of vocabulary and a grasp of language structure to allow for the accurate reading of newspaper and magazine articles as well as modern literature.

**Course Content**
- **Lektion 8 – Beruf und Arbeit**
- **Grammatik – modale Praposition als; Präteritum; Wortbildung Nommen**
- **Lektion 9 – Amter und Behorden**
- **Grammatik – Modalverben; Satzklammer; Pronomen; Imperativ**
- **Lektion 10 – Gesundheit und Krankheit**
- **Grammatik – Possessivartikel; Modalverb; Satzklammer**
- **Lektion 11 – In der Stadt unterwegs**
- **Midterm exam**
- **Grammatik – Praposition mit, an, auf, bei, hinter, in, neben, uber, unter, vor, zwischen, zu, nach, in**
- **Lektion 12 – Kundenservice**
- **Grammatik – Verben mit verschiedenen Präfixen; temporale Prapositionen vor, nach, bei, in**
- **Lektion 13 – Neue Kleider**
- **Grammatik – Demonstrativpronomen; Frageartikel welch; Verben mit Dativ**
- **Lektion 14 – Feste**

**Teaching Methods**
- Interactive lectures and communications with students
- Discussions and group works
- Presentations

**Assessment Methods**

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<tr>
<th>Description (%)</th>
<th>Quiz</th>
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<th>Lab/Practical Exam</th>
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<td>10 %</td>
<td>Final Exam</td>
<td>50 %</td>
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</tr>
</tbody>
</table>

**Learning Outcomes**
After completion of this course, students should be able to:
1. Demonstrate the confidence and listening/speaking skills necessary to participate successfully in spontaneous aural/oral exchanges with native speakers of those particular languages.
2. Demonstrate reading comprehension of foreign language texts intended for developmental (or higher level) foreign language courses.
3. Respond appropriately to written or spoken foreign language by writing paragraphs or short essays that communicate ideas clearly.

**Prerequisite Course(s)**

**Language of Instruction**
Bosnian and German

**Mandatory Literature**
- Schritte plus 2 Audio-CD zumArbeitsbuchmitinteraktivenÜbungen, Monika Bovermann, Daniela Niebisch, Franz Specht, Sylvette Penning-Hiemstra

**Recommended Literature**

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
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<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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<tr>
<td>Seminar / Presentation</td>
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**Total Workload**

| ECTS Credit (Total Workload / 25) | 2 |
**Course Code:** MAN 104  
**Course Name:** INTRODUCTION TO BUSINESS  
**Level:** Undergraduate  
**Year:** II  
**Semester:** III  
**ECTS Credits:** 5

**Status:** Elective  
**Hours/Week:** 2+1  
**Total Hours:** 30+15

### Course Description
This course presents a balanced view of business; the strengths, weaknesses, successes, failures, problems, and challenges. It provides students a base for more advanced courses.

### Course Objectives
The objective of this course is to provide students a clear and complete description of the concepts underlying business and illustrate the dynamism and liveliness of business organizations and people who operate them with real life examples.

### Course Content
- Motives and Functions of a Business
- Business Ethics and Social Responsibility
- Assessing Economic Conditions
- Assessing Global Conditions
- Selecting a Form of Business Ownership
- Entrepreneurship and Business Planning
- Managing Effectively
- Midterm Exam
- Organizational Structure
- Improving Productivity and Quality
- Motivating Employees
- Hiring, Training, and Evaluating Employees
- Creating and Pricing Products
- Distributing Products
- Promoting Products

### Teaching Methods Description
- Interactive lectures and communication with students
- Discussions and group work
- Problem solving or case studies
- Practical Sessions

### Assessment Methods Description (%)

<table>
<thead>
<tr>
<th>Activity</th>
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</table>

**Total:** 100%

### Learning Outcomes
After completion of this course, students should be able to:
1. Describe the functional areas of business.
2. Explain factors that influence the business environment.
3. Identify distinguishing characteristics of business formation.
4. Examine the key functions of management.
5. Describe the role of product, price, place and promotion in marketing.
6. Communicate effectively through written and oral presentation assignments.
7. Recognize the key areas of money, finance and investments.

### Prerequisite Course(s)
- 

### Language of Instruction
English

### Mandatory Literature

### Recommended Literature

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
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<tbody>
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**Total Workload:** 124

**ECTS Credit (Total Workload / 25):** 5
## Course Description

This course will provide students with an understanding of issues facing entrepreneurs and an exposure to the skills involved in addressing them. We will explore how executives should approach making critical decisions during the different phases of an entrepreneurial company's life. Starting from the vantage point of the individual, we will put ourselves in the shoes of decision makers ranging from technology entrepreneurs to venture capitalists, from real estate developers to inventors.

## Course Objectives

Objectives of this course are: developing an understanding of entrepreneurship and the entrepreneurial process; assessing the feasibility of new business concepts and ideas; developing skills in new business venture management including opportunity recognition, business model construction, market assessment, and financial planning; identifying resources and skills needed to grow a new venture business; analyzing various exit strategies for new business ventures; creating business plans for development and financing of new business ventures.

## Course Content

- **Introduction – Syllabus; The Power of Entrepreneurship;**
- **Learn to Think like an Entrepreneur; Resource Needs and Profit Potential;**
- **When an Idea is a Good Opportunity; How to construct a great pitch; Matching your skills to the opportunity;**
- **Minimum Viable Product; Customer Validation; Pivoting; Exercise: Voice of the Customer**
- **Marketing Strategy for Entrepreneurs; Managing Growth;**
- **Founding Team and Culture;**

- **The Business Planning Process; BPP part 2**
- **Midterm Exam**
- **Who are you Customers?; The Business Model; Attracting People Creating Buzz**
- **What investors want; Microcredit – How much to raise?;**
- **Happiness is Positive Cash Flow; CCC**
- **Bootstrapping; Financing a New Venture; Sustaining Growth; Leadership; Execution**
- **Team Project Presentations; Team Project Presentations**
- **Conclusion and Final Exam Review**

## Assessment Methods Describe (%)

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<th>Duration</th>
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</table>

## Learning Outcomes

After completion of this course, students should be able to:
1. Identify potentially valuable opportunities.
2. Obtain resources necessary to pursue an opportunity and to create an entrepreneurial organization.
3. Manage the entrepreneurial organization once it has been established.
4. Grow the business into a sustainable enterprise.
5. Create and harvest value for the organizational stakeholders.

## Prerequisite Course(s)

- 

## Language of Instruction

English

## Mandatory Literature


## Recommended Literature

- 

## ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
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<th>Activities</th>
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## Course Code: MAN 327  
## Course Name: OPERATIONS RESEARCH

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### Course Description
Operations research helps in solving problems in different environments that need decisions. The module converts topics that include: linear programming, Transportation, Assignment, and CPM/MSPT techniques. Analytic techniques and computer packages will be used to solve problems facing business managers in decision environments.

### Course Objectives
This module aims to introduce students to use quantitative methods and techniques for effective decision-making; model formulation and applications that are used in solving business decision problems.

### Course Content
- Introduction to operations research (OR)
- Introduction to foundation mathematics and statistics
- Linear programming (LP), LP and allocation of resources, LP definition, linearity requirement
- Maximization then minimization problems.
- Graphical LP minimization solution, introduction, simplex method definition, formulating the simplex model.
- Mixed limitations
- Preparation for Midterm
- Midterm Exam

- Example containing mixed constraints, minimization example for similar limitations.
- Sensitivity analyses: changes in objective function, changes in RHS, the transportation model
- Basic assumptions
- Solution methods:
  - Feasible solution: the northwest method, the lowest cost method;
  - Optimal solution: the stepping stone method, modified; distribution (MODI) method.
- The assignment model-basic assumptions

### Teaching Methods Description
- Interactive lectures and communication with students
- Discussions and group work
- Problem solving or case studies
- Practical Sessions

### Assessment Methods Description (%)

<table>
<thead>
<tr>
<th>Assessment Method</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz</td>
<td>0 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homework</td>
<td>0 %</td>
<td></td>
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</tr>
<tr>
<td>Project</td>
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</tr>
<tr>
<td>Midterm Exam</td>
<td>20 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentation</td>
<td>10 %</td>
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</tr>
<tr>
<td>Lab/Practical Exam</td>
<td>0 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term Paper</td>
<td>0 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attendance</td>
<td>10 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class Deliverables</td>
<td>0 %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final Exam</td>
<td>50 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Total 100 %**

### Learning Outcomes
After completion of this course, students should be able to:
1. Differentiate characteristics of different types of decision-making environments and the appropriate decision making approaches and tools to be used in each type.
2. Build and solve transportation models and assignment models.
3. Design new simple models, like: CPM, MSPT to improve decision-making and develop critical thinking and objective analysis of decision problems.
4. Identify and develop operational research models from the verbal description of the real system.
5. Use mathematical software to solve the proposed models

### Prerequisite Course(s)

### Language of Instruction
English

### Mandatory Literature

### Recommended Literature

### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
<thead>
<tr>
<th>Activities</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture (15 weeks x Lecture hours per week)</td>
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</tr>
<tr>
<td>Laboratory / Practice (15 weeks x Laboratory / Practice hours per week)</td>
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<tr>
<td>Midterm Examination (1 week)</td>
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</tr>
<tr>
<td>Seminar / Presentation</td>
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<td>10</td>
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</tbody>
</table>

**Total Workload 120**

**ECTS Credit (Total Workload / 25)** 5
Course Code: MAN 211  
Course Name: LEADERSHIP  

Level: Undergraduate  
Year: II  
Semester: IV  
ECTS Credits: 5  

Status: Elective  
Hours/Week: 2+1  
Total Hours: 30+15  

Course Description  
The student are learning about theoretical aspects of leadership and how to implement that knowledge into practice.  

Course Objectives  
Objective of this course is to give students knowledge of leadership theory and practice. The student will also develop self-knowledge of his or her leadership philosophy and preferred leadership styles along with a skill for successful analysis of cases involving leadership.  

Course Content  
- Introduction: The Nature  
- Managerial Traits and Skills  
- The Nature of Managerial Work  
- Perspectives on Effective Leadership Behavior  
- Participative Leadership, Delegation and Empowerment  
- Early Contingency Theories of Effective Leadership  
- Power and Influence  
- Midterm Exam  
- Dyadic Relations, Attributions  
- Charismatic and Transformational Leadership  
- Leading Change in Organizations  
- Ethical, Servant, Spiritual  
- Leadership in teams and Decision Groups  
- Strategic Leadership by Executives  
- Developing Leadership skills  

Teaching Methods  
- Lectures  
- Presentations  
- Project  
- Assignments  

Assessment Methods  
- Quiz: 0 %  
- Homework: 10 %  
- Project: 20 %  
- Midterm Exam: 20 %  
- Presentation: 10 %  
- Lab/Practical Exam: 0 %  
- Term Paper: 0 %  
- Attendance: 0 %  
- Class Deliverables: 0 %  
- Final Exam: 40 %  

Total Workload: 124  
ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)  

Activities  
<table>
<thead>
<tr>
<th>Description</th>
<th>Quantity</th>
<th>Duration</th>
<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture (15 weeks x Lecture hours per week)</td>
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<tr>
<td>Laboratory / Practice (15 weeks x Laboratory / Practice hours per week)</td>
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<tr>
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<td>Final Examination (1 week)</td>
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<tr>
<td>Seminar / Presentation</td>
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</table>

Total Workload: 124  
ECTS Credit (Total Workload / 25): 5
<table>
<thead>
<tr>
<th>Course Code: ELT 121</th>
<th>Course Name: ORAL COMMUNICATION SKILLS I</th>
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<tbody>
<tr>
<td>Level: Undergraduate</td>
<td>Year: II</td>
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<tr>
<td>Status: Elective</td>
<td>Hours/Week: 2+2</td>
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</table>

**Course Description**
This course offers a variety of different communication-oriented speaking activities such as discussions, individual presentations and other interactive tasks providing opportunity for students to improve their oral competence by developing effective language use in both formal and informal contexts. By exploring components of communicative competence, this course aims to equip students with the necessary skills to become successful communicators as well as language teachers. Students will utilize the theoretical and practical knowledge acquired in listening and pronunciation courses in delivering brief informative, persuasive presentations.

**Course Objectives**
The general goal of this course is to develop the student’s ability to communicate effectively and with ease in a variety of different spoken contexts. More specifically, the student will begin to transition from learning English to learning through English, that is to say, using English in an academic environment.

**Course Content**
- Psychology
- The First Day in Social Psychology Class
- The Pace of a Place
- Business
- Business innovation
- Global Business: The Case of MTV
- Media Studies
- Midterm Exam
- Celebrities and Media
- Communication Revolutions Science
- How Sleep Affects Thinking
- The Influence of Geography on Culture
- Humanities
- The Story of Fairy Tales
- Architecture: Form or Function?

**Teaching Methods Description**
- Interactive lectures
- Tutorial

**Assessment Methods Description (%)**

<table>
<thead>
<tr>
<th>Assessment Method</th>
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<th>Workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz</td>
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</tr>
<tr>
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<td>0 %</td>
<td>Term Paper</td>
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<td>Project</td>
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<td>Attendance</td>
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<tr>
<td>Midterm Exam</td>
<td>30 %</td>
<td>Class Deliverables</td>
<td>0 %</td>
</tr>
<tr>
<td>Presentation</td>
<td>20 %</td>
<td>Final Exam</td>
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<tr>
<td><strong>Total</strong></td>
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<td>100 %</td>
</tr>
</tbody>
</table>

**Learning Outcomes**
After completion of this course, students should be able to:
1. Evaluate the effectiveness of a presentation, lecture, or speech.
2. Identify signal words and vocal inflections that indicate patterns of organization, transitions, emphasis, and point of view.
3. Orally paraphrase and summarize the content of a presentation, lecture, speech, or meeting.
4. Prepare and present effective introductions, supporting ideas, and conclusions.
5. Prepare formal and informal speech.

**Prerequisite Course(s)**
- 

**Language of Instruction**
English

**Mandatory Literature**
- Peg Sarosy and Kathy Sherak, Lecture Ready 1, Oxford, 2007

**Recommended Literature**
- Logan, Craig Thaine Cambridge English Skills Real Listening and Speaking, Cambridge University Press, 2008

**ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)**

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</tr>
<tr>
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<tr>
<td>Seminar / Presentation</td>
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</table>

**Total Workload**
125

**ECTS Credit (Total Workload / 25)**
5
Course Code: ELT 122  
Course Name: ORAL COMMUNICATION SKILLS II  
Level: Undergraduate  
Year: II  
Semester: IV  
ECTS Credits: 5

### Course Description
This course is a continuation of Oral Communication Skills I. It offers extended communicative tasks such as debates, role-plays, individual and group presentations, impromptu speeches and other interactive tasks providing opportunity for students to improve their oral competence by developing effective language use in both formal and informal contexts. The course includes discussion topics, interesting facts, stimulating quotes as well as literary texts which are structurally and intellectually complex and thought-provoking.

### Course Objectives
This course offers a variety of different communication-oriented speaking activities such as discussions, individual presentations and other interactive tasks providing opportunity for students to improve their oral competence by developing effective language use in both formal and informal contexts. By exploring components of communicative competence, this course aims to equip students with the necessary skills to become successful communicators as well as language teachers.

### Course Content
- How Sleep Affects Thinking
- The Influence of Geography on Culture
- The Story of Fairy Tales
- Architecture: Form or Function?
- The Man Who Swapped Lives
- Pizza-man Gives Away
- Preparation for Midterm Exam
- Midterm Exam
- Project Evaluation
- Disciplining Children
- International Companies (1)
- International Companies (2)
- Does Prison Work?
- Project presentations
- Preparation for Final Exam

### Teaching Methods
- Interactive lectures
- Tutorial

### Assessment Methods

<table>
<thead>
<tr>
<th>Description</th>
<th>Quiz</th>
<th>Lab/Practical Exam</th>
<th>Homework</th>
<th>Term Paper</th>
<th>Project</th>
<th>Attendance</th>
<th>Midterm Exam</th>
<th>Class Deliverables</th>
<th>Presentation</th>
<th>Final Exam</th>
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<tbody>
<tr>
<td>%</td>
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<td>100</td>
</tr>
</tbody>
</table>

### Learning Outcomes
After completion of this course, students should be able to:
1. Evaluate the effectiveness of a presentation, lecture, or speech.
2. Identify signal words and vocal inflections that indicate patterns of organization, transitions, emphasis, and point of view.
3. Orally paraphrase and summarize the content of a presentation, lecture, speech, or meeting.
4. Prepare and present effective introductions, supporting ideas, and conclusions.
5. Prepare formal and informal speech.

### Prerequisite Course(s)

### Language of Instruction
English

### Mandatory Literature
- There is a class website available at www.ibuenglish123a.blogspot.com and www.ibuenglish123b.blogspot.com which contains the weekly readings and discussion questions. Students are reminded to consider the website their textbook and check it regularly to prepare for class. Additional handouts will be distributed as required.

### Recommended Literature

### ECTS (ALLOCATED BASED ON STUDENT’S WORKLOAD)

<table>
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<tr>
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<tr>
<td>Final Examination (1 week)</td>
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<td>Preparation for Final Examination</td>
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<tr>
<td>Assignment / Homework / Project</td>
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</tr>
<tr>
<td>Seminar / Presentation</td>
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Total Workload: 125

ECTS Credit (Total Workload / 25): 5