UNIVERSITY OF EAST SARAJEVO
FACULTY OF ELECTRICAL ENGINEERING
EAST SARAJEVO

FIRST STUDY CYCLE
STUDY PROGRAM
COMPUTER SCIENCE AND INFORMATICS

East Sarajevo, 2023.

ORGANIZATIONAL UNIT	
Name of the organizational unit	Faculty of Electrical Engineering
City	East Sarajevo
Municipality of the organizational unit	East New Sarajevo
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Organizational code in the Treasury of the RS	12510005
PIN of the organizational unit	4400592530093
VAT number of the organizational unit	400592530093
Identity number assigned by the Republic Institute of Statistics	01029606
Dean of the organizational unit	PhD Božidar Popović, Associate Professor

CURRICULUM

FIRST STUDY CYCLE

- COMPUTER SCIENCE AND INFORMATICS -

Teaching activities at the Faculty of Electrical Engineering in East Sarajevo are organized in three study cycles. Study cycles are carried out through study programs.

The first study cycle prepares students for a higher degree of study and enables them to acquire general and specific knowledge needed for employment in certain professional jobs. Upon completion of the first study cycle, the academic title of Bachelor of Science (B.Sc.) in Electrical Engineering is acquired, with an indication of the study program. Along with the diploma of the first study cycle, a diploma supplement is also issued for a more detailed insight into the level, nature, content, system and rules of study and the results achieved during studies. The educational degree of the first cycle in all study programs lasts four study years, i.e. eight semesters, which corresponds to 240 ECTS points.

The first study cycle is realized through the following study programs:

- Electric Power Engineering,
- Automation and Electronics,
- Computer Science and Informatics.

The decision for the final study program is made when enrolling at the faculty.

The general goals of the first study cycle at the Faculty of Electrical Engineering in East Sarajevo are efficient and rational higher education of personnel in the field of electrical engineering, through:

- guiding and helping the student during the teaching process,
- the introduction of only one-semester courses with a maximum of six hours of direct teaching,
- relieving teaching content of unnecessary repetitions and facts, with the necessary modernization that follows the rapid development in various areas of electrical engineering, increasing the number of hours of exercises and practical work compared to lectures,
- establishing a system of rules and criteria for quality assurance (QA) of the educational process,
- guidance through optional subjects,
- continuous monitoring and checking of students' knowledge,
- application of modern didactic methods.

Also, a modern multidisciplinary educated electrical engineering graduate who can successfully work in the economy and services where there is a need for this profile of personnel, is educated through:

- the introduction of optional subjects, which under certain conditions can also be subjects from another study program,
- introduction of common program contents for all study programs,
- the introduction of two practically oriented projects, which are valued as special subjects and obligations of professional practice.

The goal of the first study cycle is the professional preparation of the candidate for continuing education, in the second study cycle through:

- hiring teaching staff with recognized scientific results who are capable of motivating students for further professional and scientific training,
- introduction of the most modern teaching content in the professional part of studies, which can be a motivation and challenge for students to engage in scientific work.

General outcome of the learning process at the end of the first study cycle:

- knowledge and understanding of basic principles in the field of study,
- recognition of problems that arise in practice and the possibility of their quick and economical solution, using the most modern technical achievements in the specific field,
- ability to work in a team in a multidisciplinary environment,
- within the specialty and beyond, to follow the development and latest technical achievements and recognize the needs and opportunities to apply these achievements in the environment,
- developing the skills of self-learning, which enables to get the necessary comprehensive education,
- to respect legal regulations and social norms of behavior.

The first two years of study are common for all students, regardless of the chosen study program. All subjects in the first two years are compulsory. Here, students acquire the general knowledge necessary to continue with the chosen study programs.

In the third and fourth year of study, students are directed to the above three study programs. Students acquire knowledge specific to the study program they have chosen. A number of subjects are compulsory, while the rest are optional and chosen by students based on their interests and affinities. After completing eight semesters, each student works on and defends a final thesis. Students are able to apply the theoretical and practical knowledge acquired in targeted study programs in practice, and it also serves as a basis for continuing their studies in the second study cycle.

DEAN

Prof. Božidar Popović

Qualification model				
Study program	**The name of the qualification according to the Law on Professions in RS**	**English name of the qualification**	**Level of educational qualification according to the standard (EKO, EQF)**	**Work permit number**
I - the first study cycle				
COMPUTER SCIENCE AND INFORMATICS	Дипломирани инжењер електротехнике – 240 ECTS – Рачунарство и информатика	*Bachelor of science in Electrical Engineering –240 ECTS – Computer Science and Informatics*	7	**07.023-3899/09** from 22. 06. 2009.

QUALIFICATIONS STANDARD FOR THE STUDY PROGRAM: COMPUTER SCIENCE AND INFORMATICS

1. BASIC CHARACTERISTICS

Study cycle: *First study cycle*
Degree: *Academic*
Study program: *Computer Science and Informatics*

Name(s) of qualification (generic part + specific part):

Bachelor of science in Electrical Engineering – 240 ECTS – Computer Science and Informatics

Language of study: *English*

Study duration: *The study lasts four years, and the year consists of two semesters (winter and summer).*

Minimum volume - number of ECTS: *240 ECTS credits*

Level: *7*

Conditions/method of admission: The conditions for enrollment in the first study cycle of the study program Computer Science and Informatics, which is conducted at the Faculty of Electrical Engineering in East Sarajevo, are prescribed by the Law on Higher Education, the Statute and other acts of the University of East Sarajevo and the Faculty of Electrical Engineering in East Sarajevo. All persons who have completed a four-year high school in the Republic of Srpska and Bosnia and Herzegovina, the Republic of Serbia (Agreement on Special and Parallel Connections), as well as persons who have completed a four-year high school abroad (under the obligation to certify the certificate), have the right to enroll in the Faculty of Electrical Engineering. Upon enrollment, an entrance exam in mathematics is taken.

1.1. Introduction to Qualification

At the Faculty of Electrical Engineering, University of East Sarajevo, a study program Computer Science and Informatics, highly qualified experts in the field of electrical engineering, computer, information and bioinformation sciences, are educated according to the curriculum from 2012. Through the educational profile of the Graduate Engineer of Electrical Engineering - Computer Science and Informatics, skills and knowledge are obtained for working with modern technologies in the field of computer and information sciences. Mastering interdisciplinary areas, as well as skills of collaboration and teamwork, today representing one of the key factors in the development of computer and information systems, round off the complete set of education of engineers dictated by the modern labor market.

A modern multidisciplinary graduate engineer of electrical engineering, which can successfully work in the economy and services in which there is a need for this staff can be formed in common program basis. The goal is achieved through:

- Introduction of elective subjects, which under certain conditions can also be subjects from another study program,
- introduction of common program content for all study programs, and
- Introduction of two practically oriented projects, which represent special subjects and obligations within the professional practice.

Students are also educated for organizing and implementing extracurricular activities at any cycle of education through organizing competitive and sports content, thus developing their leadership, entrepreneurial and team skills.

The first study cycle, study program Computer Science and Informatics, aims to gain of fundamental and specialist knowledge and skills in the field of electrical engineering, software and computer engineering, as well as analysis, design, and implementation of software and hardware systems of different degree of complexity, which include modern concepts and technologies. The student will also acquire knowledge that needs to be further education and training.

By successful mastering of the content of the study program Computer Science and Informatics, the student is able to effectively apply the scientific and professional achievements in the field of electrical engineering, computer, information and bioinformation sciences in education (medium and higher education), independent and professional work (software design and development), as well as to find new achievements in multidisciplinary areas that rely on application in the mentioned areas.

The goals of the study program:

- Achieving competencies, academic knowledge and specific practical applicable knowledge and skills in the field of computer, information and bioinformation sciences,
- Application of modern commercial and freely available tools and technologies in the process of developing software and computer systems,
- Identifying problems that occur in practice and the possibility of their fast and efficient solution using state-of-the-art technological achievements,
- Ability for teamwork in a multidisciplinary environment,
- Monitoring development and latest technical achievements, as well as recognizing the need and opportunities for their application in the environment,
- Development of self-containing skills, which aims to achieve lifelong learning,

- Respect for standards, legal regulations, as well as social norms of behavior.

1.2. Reasons for the existence of the qualification - justification

The purpose of the study program Computer Science and Informatics is the formation of highly educated personnel for the needs of the economy in the field of electrical engineering, computer, information and bioinformation sciences. The current situation, development trends and the needs of the market for engineers in these fields served as the basis for defining the structure and content of the study program. When designing this study program, the following strategies and opinions were additionally taken into account:

- Strategy of scientific and technological development of the Republic of Srpska 2012-2016,
- Requirements of chambers of commerce and associations of electrical engineers,
- Opinions of business entities,
- Opinions of experts from various scientific and professional disciplines.

Graduated students after the completion of this study program gain a high level of knowledge in the mentioned areas, which will allow them to see the questions more complex and make adequate decisions and conclusions. Social justification stems from the need for further development of the profession in the field of electrical engineering, computer and information sciences, and bioinformatics in Republic of Srpska – Bosnia and Herzegovina and the environment. High-quality education offered by this study program is the foundation for independent and lifelong development of software and hardware systems, which is one of the important elements that are recently current and present in the labor market. Support to this study program is also in the function of raising the quality of education and improving electrical engineering, computer and information sciences and bioinformatics in Republic of Srpska – Bosnia and Herzegovina, as well as in the forming of young engineering staff.

This study program is made up that after the end of basic academic studies (first study cycle), students acquire knowledge and skills for work on engineering tasks in the field of electrical engineering, computing, software engineering and information technologies. Graduated students (graduated engineers) are trained to apply the acquired knowledge and manner of resolving the assessments, to realize the solutions, documentation, implementation of solutions, as well as to work and communicate with experts from other areas. In addition to the basic knowledge of mathematics, physics, electrical engineering, electronics, electromagnetics and telecommunications, students adopt knowledge and skills in the field of oriented programming, algorithms and data structures, computer organizations, operating systems, databases, transmission of data, software engineering, specifications and modeling of software, communication and computer network technologies, program translators, information systems, parallel computer systems, computer graphics, artificial intelligence, computer design and modeling. In addition, the purpose of this study program is to provide a basis for the further master studies in the field of electrical engineering, computer and information sciences and bioinformatics.

Based on the above, it can be said that justification is reflected through the additional goals of the study program Computer Science and Informatics at the Faculty of Electrical Engineering, University of East Sarajevo:

- Respect for the strategic commitment of society in those domains that rely on the application of knowledge and skills and scientific fields of electrical engineering, computer and information sciences, and bioinformatics.
- Insurance that learning outcomes in the study program meet the needs and requirements of the market.

- Improving learning outcomes by introducing modern teaching methods, with the use of appropriate laboratory equipment and modern software tools,
- Creating conditions for student mobility.
- Creating the conditions for the work of professional practice and projects in successful economic entities.
- Realization of national and international cooperation in the realization of the teaching process within the study program.
- Creating opportunities for lifelong learning even after graduation.

2. COMPETENCES / LEARNING OUTCOMES

Student that completes the study program Computer Science and Informatics at the Faculty of Electrical Engineering in East Sarajevo, gains general knowledge, skills and competences which covers general areas of electrical engineering and computing, as well as specialist knowledge, skills and competencies in the main areas of computing: computer sciences, software and computer engineering, information systems and information technologies. Regardless of the choice of subjects in a professional part of the study, which allows profiling in certain areas of computing, students gain general theoretical and practical knowledge which are fundamental in the fields of electrical engineering and computing, which enable understanding of areas and easier guidance to certain profiles, as well as easier adaptation to the labor market needs.

2.1. List of competencies at the qualification level

KNOWLEDGE

Knowledge that should possess a graduated electrical engineer - study program Computer Science and Informatics, include the following:

- fundamental knowledge in the field of electrical engineering, natural sciences, foreign languages,
- fundamental knowledge in the field of programming, algorithms and data structure, databases, information and communication technologies, computer hardware, digital structures, system theories,
- specialist knowledge in the field of software and computer engineering, design and implementation of information systems, computer networks, design, implementation and management of databases, computer graphics, human and computer interactions, digital signal processing, artificial intelligence.

SKILLS

Skills that should have a graduated electrical engineer - study program Computer Science and Informatics, include the following:

- design and development of software and hardware systems of different degree of complexity,
- design user interfaces for different types of applications and devices (desktop, web, mobile, operator panels, etc.),
- design and implementation of the system with a built-in computer,
- collection, analysis and specifications of requirements, and design and implementation of information systems,
- design and implementation of databases, selection, configuration and database systems management,

- design and implementation of computer networks, selection and configuration of network components, network infrastructure and service maintenance,
- planning, specification, installation and maintenance of computer infrastructure,
- communication and interpersonal skills,
- independent and team work.

COMPETENCIES

Competences that should have a graduated electrical engineer study program Computer Science and Informatics, include the following:

- analysis of information needs of the organization and design of software systems that are in line with the goals and needs of the organization,
- participation and management of activities in any phase of life cycle of complex software and hardware systems,
- design and implementation of systems that involve the integration of hardware and software,
- efficient planning, implementation, configuration and maintenance of computer infrastructure organization,
- permanent education and training in the profession.

COMPETENCY MATRIX OF STUDY PROGRAM COMPUTER SCIENCE AND INFORMATICS	General subjects	Fundamental subjects of engineering	Professional subjects	Projects and students practice	Final thesis
Fundamental knowledge in mathematics, physics, electronics, electrical engineering, computer science and programming technics	X	X			
Independent work with basic software tools	X	X			
Ability to analyze and model different physical manifestations and entities, simple components, devices and systems from the field of electrical engineering	X	X			
Fundamental knowledge from the fields of programming, algorithms and data structures, databases, information and communication technologies, computer hardware, digital structures, and systems theory	X	X	X		
Independently conduct experiments, statistical processing of the experimental results, analyze and interpret experiments, formulate and made conclusions in order to understand the processes, devices and systems	X	X	X	X	X
Specialist knowledge in the fields of software and computer engineering, design and implementation of information systems, computer networks, design, implementation and management of the databases, computers graphics, human machine interface, digital signal processing, and artificial intelligence		X	X	X	
Ability to apply acquired theoretical knowledge in practice			X	X	
Ability to apply standards, technical norms and regulations			X	X	X
Ability to successfully participate in teamwork, to have basic skills of leadership in the project teams			X	X	
Ability to develop critical opinions, to identify and analyze problems, predict behavior of the selected solution with clear outcome of the good and/or bad choice			X	X	X
Ability to use scientific and professional literature	X	X	X		
Specially trained for combination of basic knowledge from different scientific and professional fields, considering the specifics of the study program Computer Science and Informatics			X	X	X
Competent to apply theoretical and practical knowledge based on the scientific principles for solving of complex and realistic problems from practice			X	X	X
Completely trained for continuation of scientific and research work, trained for publication of scientific and professional papers in scientific fields computer and information sciences and bioinformatics		X	X		X
Has developed professional ethics and respect of professional norms			X	X	X
Understanding the importance and role of knowledge, experience and skills in making decisions on all levels of industrial/business environment			X	X	X

2.2. Qualification and course structure

SCHEDULE OF ECTS POINTS ACCORDING TO COURSE GROUPS/list of basic and elective subjects/

Subject group	ECTS (minimum)
General - Theoretical subjects important for study of engineering	70 ECTS credits
− Mathematics - 1	7,0
− Mathematics - 2	7,0
− Mathematics - 3	6,0
− Fundamentals of Electrical Engineering - 1	7,0
− Fundamentals of Electrical Engineering - 2	7,0
− Physics	6,5
− Physical Fundamentals of Electronics	5,5
− Fundamentals of Computer Technique	5,5
− Introduction to Programming	5,5
− Application Software	3,0
− English Language - 1	2,0

Subject group	ECTS (minimum)
− English Language - 2	2,0
− English Language - 3	2,0
− English Language - 4	2,0
− Introduction to Management	2,0
Professional - fundamental subjects of engineering	54 ECTS credits
− Electric Circuits Theory - 1	5,0
− Electric Circuits Theory - 2	5,0
− Electronics - 1	6,0
− Electronics - 2	5,0
− Electromagnetics - 1	6,0
− Electrical Measurements	5,0
− Numerical Mathematics	6,0
− Discrete Mathematics	5,0
− Fundamentals of Telecommunications	5,0
− Digital Electronics	6,0
Professions subjects	79 ECTS credits
− Programming Languages	6,0
− Object Oriented Programming	6,0
− Operating Systems	5,0
− Computer Architecture and Organization	6,0
− Practical Teaching	3,0
− Algorithms and Data Structures	5,0
− Databases	7,0
− Data Transmission	6,0
− Computer Networks	5,0
− Program Compilers	5,0
− Microprocessor Systems	5,0
− Internet Technologies and Programming	7,0
− Information Systems Design	7,0
− Parallel Computer Systems	6,0
Elective program - General	5 ECTS credits
− Management in Engineering Practice	5,0
Elective program - Professional	45 ECTS credits
− Controllers and Input – Output Devices	5,0
− Digital Signal Processing	5,0
− Programming Techniques and Methods	5,0
− Software Specification and Modelling	5,0
− Digital Systems	5,0
− Software Design	5,0
− Computer Graphics	5,0
− Artificial Intelligence	5,0
− Database Software Tools	5,0
Projects and practice	7 ECTS credits
− Project – 1	2,0
− Project – 2	2,0

Subject group	ECTS (minimum)
− Ferial Practice	3,0
Final work	5 ECTS credits
− Final Paper (Thesis)	5,0

2.3. Curriculum plan of the Study Program of Computer Science and Informatics

	UNIVERSITY OF EAST SARAJEVO - FACULTY OF ELECTRICAL ENGINEERING	
	Study program:	**Computer Science and Informatics**

Ordinal number	Subject code	Full name of the course	Status (Compulsory/ Elective)	Conditional subjects	Semester	Number of lessons/ teaching workload (weekly)			ECTS
						L	AE	LE	
FIRST YEAR									
1.	RI-08-1-001-1	Mathematics – 1	C	No	I	3	3	0	7.0
2.	RI-08-1-002-1	Physics	C	No	I	3	1	1	6.5
3.	RI-08-1-003-1	Fundamentals of Electrical Engineering – 1	C	No	I	3	2	1	7.0
4.	RI-08-1-004-1	Fundamentals of Computer Technique	C	No	I	2	0	2	5.5
5.	RI-08-1-005-1	Introduction to Management	C	No	I	2	0	0	2.0
6.	RI-08-1-007-1	English Language – 1	C	No	I	1	1	0	2.0
7.	RI-08-1-008-2	Mathematics – 2	C	No	II	3	3	0	7.0
8.	RI-08-1-009-2	Introduction to Programming	C	No	II	2	1	2	5.5
9.	RI-08-1-010-2	Fundamentals of Electrical Engineering – 2	C	No	II	3	2	1	7,0
10.	RI-08-1-011-2	Physical Fundamentals of Electronics	C	No	II	2	2	0	5.5
11.	RI-08-1-012-2	Application Software	C	No	II	0	0	2	3.0
12.	RI-08-1-013-2	English Language – 2	C	No	II	1	1	0	2.0
				IN TOTAL:		**25**	**16**	**9**	**60**
SECOND YEAR									
1.	RI-08-1-014-3	Mathematics – 3	C	No	III	3	2	0	6.0
2.	RI-08-1-015-3	Electric Circuits Theory – 1	C	No	III	2	2	0	5.0
3.	RI-08-1-016-3	Electrical Measurements	C	No	III	2	1	1	5.0
4.	RI-08-1-017-3	Electronics – 1	C	No	III	3	2	1	6.0
5.	RI-08-1-018-3	Programming Languages	C	No	III	2	1	1	6.0
6.	RI-08-1-019-3	English Language – 3	C	No	III	1	1	0	2.0
7.	RI-08-1-020-4	Numerical Mathematics	C	No	IV	2	2	1	6.0
8.	RI-08-1-020-4	Electric Circuits Theory – 2	C	No	IV	2	1	1	5.0
9.	RI-08-1-022-4	Electromagnetics – 1	C	No	IV	3	3	0	6.0
10.	RI-08-1-023-4	Electronics – 2	C	No	IV	2	1	1	5.0
11.	RI-08-1-024-4	Object Oriented Programming	C	No	IV	2	1	1	6.0
12.	RI-08-1-025-4	English Language – 4	C	No	IV	1	1	0	2.0
				IN TOTAL:		**25**	**18**	**7**	**60**
THIRD YEAR									
1.	RI-08-1-078-5	Discrete Mathematics	C	No	V	2	2	0	5,0
2.	RI-04-1-041-5	Fundamentals of Telecommunications	C	No	V	2	2	0	5,0
3.	RI-08-1-033-5	Digital Electronics	C	No	V	2	1	2	6,0
4.	RI-06-1-111-5	Operating Systems	C	No	V	2	1	1	5,0
5.	RI-04-1-075-5	Computer Architecture and Organization	C	No	V	3	1	1	6,0

6.	RI-06-1-157-5	Practical Teaching	C	No	V	1	0	2	3,0
7.	RI-08-1-073-6	Algorithms and Data Structures	C	No	VI	2	2	0	5,0
8.	RI-08-1-076-6	Databases	C	No	VI	3	1	2	7,0
9.	RI-08-1-118-6	Data Transmission	C	No	VI	2	1	2	6,0
10.	RI-08-1-035-6	Project – 1	C	No	VI	0	0	2	2,0
11.	RI-08-2-xxx-6	Optional subject CSI – 3.1	E	No	VI	2	2	0	5,0
12.	RI-08-2-xxx-6	Optional subject CSI – 3.2	E	No	VI	2	2	0	5,0
					IN TOTAL:	**23**	**15**	**12**	**60**
FOURTH YEAR									
1.	RI-08-1-130-7	Computer Networks	C	No	VII	2	1	1	5,0
2.	RI-08-1-125-7	Program Translators	C	No	VII	2	1	1	5,0
3.	RI-08-1-043-7	Microprocessor Systems	C	No	VII	2	1	1	5,0
4.	RI-08-1-095-7	Internet Technologies and Programming	C	No	VII	2	2	1	7,0
5.	RI-08-1-045-7	Ferial Practice	C	No	VII	0	0	4	3,0
6.	RI-08-2-xxx-7	Optional subject CSI - 4.1	E	No	VII	2	2	0	5,0
7.	RI-08-1-126-8	Information Systems Design	C	No	VIII	3	2	1	7,0
8.	RI-08-1-115-8	Parallel Computer Systems	C	No	VIII	2	1	2	6,0
9.	RI-08-1-053-8	Project – 2	C	No	VIII	0	0	2	2,0
10.	RI-08-2-xxx-8	Optional subject CSI - 4.2	E	No	VIII	2	2	0	5,0
11.	RI-08-2-xxx-8	Optional subject CSI - 4.3	E	No	VIII	2	2	0	5,0
12.	RI-08-1-054-8	Final Paper	C	No	VIII	0	0	4	5,0
					IN TOTAL:	**19**	**14**	**17**	**60**

Elective courses Computer Science and Informatics									
THIRD YEAR									
1.	RI-08-2-099-6	Controllers and Input – Output Devices	E	No	VI	2	2	0	5.0
2.	RI-08-2-039-6	Digital Signal Processing	E	No	VI	2	2	0	5.0
3.	RI-08-2-143-6	Programming Techniques and Methods	E	No	VI	2	2	0	5.0
4.	RI-06-2-179-6	Software Specification and Modelling	E	No	VI	2	2	0	5.0
5.	RI-05-2-180-6	Digital Systems	E	No	VI	2	2	0	5.0
6.		One elective subject from III year of study, VI semester, from other study programs	E	No	VI	2	2	0	5.0
FOURTH YEAR									
1.	RI-05-2-181-7 RI-05-2-181-8	Software Design	E	No	VII VIII	2	1	1	5.0
2.	RI-08-2-129-7 RI-08-2-129-8	Computer Graphics	E	No	VII VIII	2	2	0	5.0
3.	RI-08-2-077-7 RI-08-2-077-8	Artificial Intelligence	E	No	VII VIII	2	2	0	5.0
4.	RI-08-2-133-7 RI-08-2-133-8	Database Software Tools	E	No	VII VIII	2	2	0	5.0
5.	RI-08-2-047-7 RI-08-2-047-8	Management in Engineering Practice	E	No	VII VIII	2	2	0	5.0
6.		One elective subject from IV year of study, corresponding semester, from other study programs	E	No	VII VIII	2	2	0	5.0

FIRST YEAR

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / First year of study	

Full name of the course	**MATHEMATICS 1**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-001-1	compulsory	I	7.0

Teacher	Assistant Professor Nataša Pavlović Komazec
Associate	Assistant Professor Nataša Pavlović Komazec

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
3	3	0	60	60	0	1.33

total teaching workload (in hours, per semester) W= 3*15 + 2*15 + 0*15 =90 hours	total student workload (in hours, per semester) T= 3*15*S_o + 3*15*S_o + 0*15*S_o = 120 hours

Total workload of the subject (teaching + student): In_{opt}= W + T =90 + 120 = 210 hours per semester

Learning outcomes	By mastering this subject, the student will be able to: 1. build his thought structures, i.e. mathematical thinking, which is the carrier of every scientific endeavor, and especially of engineering creations 2. master basic mathematical terms: relation, function and operation, as well as elements of combinatorics and graph theory 3. master algebraic structures: groupoid, group, ring, field, vector space, matrix 4. learn the methods for solving systems of linear equations 5. master the theory of limit values of real sequences and functions 6. master the elements of differential calculus and its applications
Prerequisites	There are no requirements for listening.
Teaching methods	The teaching process is realized mainly through a frontal form of work - lectures and an interactive form of work - auditory exercises
Subject content per weeks	1. Relations and Functions. Permutations and Combinations. Newton 's Binomial Theorem. 2. Graph Theory. 3. Introduction to Groups, Rings and Fields. The Field of Real Numbers. 4. The Field of Complex Numbers. Polynomial and Rational Functions. 5. Vector Space. Linear Operators. 6. Determinants and Matrices. 7. Systems of Linear Equations: Cramer's Rule, Gauss Elimination Method. 8. Rank of a Matrix. Kronecker-Capelli Theorem. Eigenvalues and Eigenvectors. 9. Scalar Product of Vectors. Unitary Vector Space. Vectors and Geometry in Three Dimensions. 10. Cardinal Number of a Set. A Sequence of Real Numbers. Monotone Sequences. Euler's Number (e). 11. Metric Space. Sequences and Convergence in Metric Spaces. Banach Fixed Point Theorem. 12. Limits of Real Functions. Continuous Function. 13.The Derivative Function. Mean Value Theorems. 14. Applications of the Mean Value Theorem. L'Hopital's Rule. Higher Order Derivatives.

	15. Convex Function. Taylor's Formula. Investigation of Functions.		
Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Murray H. Protter	Basic Elements of Real Analysis, Springer	1998	
R. Magnus	Fundamental Mathematical Analysis, Springer	2020	
H. Anton, C. Rorres	Elementary Linear Algebra -11th edition, Wiley	2014	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
A. Croft, R. Devison, M. Hargreaves, J. Flint	Engineering Mathematics, Person	2017	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	homework	5	5%
	midterm exam I	30	30%
	midterm exam II	30	30%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / First year of study	

Full name of the course	**PHYSICS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-01-1-002-1	compulsory	I	6,5

Teacher(s)	Dr Zoran Ljuboje, full professor
Associate(s)	Vesna Miletic, msc

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
3	1	1	$3*15*S_o$	$1*15*S_o$	$1*15*S_o$	1.4

total teaching workload (in hours, per semester) W=3*15 + 1*15 +1*15=75h	total student workload (in hours, per semester) $T=3*15*S_o+ 1*15*S_o +1*15*S_o = 105h$

Total workload of the subject (teaching + student): In_{opt}= 75 + 105 = 180 hours per semester

Learning outcomes	Introducing students to the basics of certain areas of physics that are necessary for electrical engineering students. Introducing students to classical mechanics. Introducing students to certain areas of thermodynamics and optics.
Prerequisites	There are no requirements for listening and passing the course.
Teaching methods	Lectures, auditory exercises, seminar papers, laboratory exercises
Subject content per weeks	1. Introduction. Introduction to Newtonian mechanics. Kinematics. Translational movement of a material point. 2. Kinematics. Rotational motion of a material point. 3. Dynamics of the material point. 4. Work, power and energy. 5. Introduction to the special theory of relativity 6. Dynamics of rotational motion of solid bodies. 7. Oscillatory motion. 8. Examples of harmonic oscillator 9. Mechanical waves. 10. Elements of thermodynamics. An ideal gas. 11. Work and heat. Laws of thermodynamics. 12. Basics of the molecular-kinetic theory of gases. 13. Maxwell-Boltzmann statistics. 14. Introduction to optics. Geometric optics 15. Wave optics

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Zoran Ljuboje	FIZIKA, ETF, Univerzitet u Istočnom Sarajevu.	2008.	3-132
G. Dimić, M. Mitrinović	ZBIRKA ZADATAKA IZ FIZIKE, Viši kurs D Beograd	1991.	-

Additional literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

I. V. Saveljev	OPŠTI KURS FIZIKE, prevod ETF Sarajevo	1969.	-

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	midterm exam I	20	20%
	midterm exam II	20	20%
	lab. exercises/practical work	15	15%
	final exam (written/oral)	40	40%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / First year of study	
Full name of the course	**FUNDAMENTALS OF ELECTRICAL ENGINEERING – 1**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-003-1	Compulsory	I	7.0

Teacher(s)	PhD Srđan Lale, assistant professor
Associate(s)	MA Bojana Čolić, BA Zorana Mandić

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
3	2	1	60	40	20	1.33

total teaching workload (in hours, per semester) W= 3*15 + 2*15 + 1*15 =90 hours	total student workload (in hours, per semester) T= 3*15*So + 2*15*So + 1*15*So = 120 hours

Total workload of the subject (teaching + student): Inopt= W+T=Uopt= 90 + 120 = 210 hours per semester

Learning outcomes	By mastering this subject, the student will be able to: 1. Explain the basic concepts and laws of electrostatics and DC currents, 2. Calculates electric force, field, potential, voltage, flux and electric field energy, 3. Determine the expression for the capacitance of various systems of conducting bodies 4. Apply Ohm's law, Kirchhoff's laws, and electrical network theorems to solve electrical networks with DC currents, with and without capacitors, 5. Use the knowledge of this subject in the Fundamentals of Electrical Engineering - 2 and subsequent electrical engineering subjects
Prerequisites	There are no requirements for registering and listening to the subject.
Teaching methods	Lectures (with with the use of modern audiovisual equipment), auditory exercises and laboratory exercises. Students also receive homework.
Subject content per weeks	1. Concept of electric load. Coulomb's law and electric field vector. Distributed charges. 2. Electric field potential, potential difference and voltage. Electric dipole. 3. Vector flux. Gauss's law. Examples of the application of Gauss's law. 4. Conductors in an electrostatic field. Electrostatic induction. Mirroring method. 5. Capacitors and capacitance. Series, parallel and mixed connection of capacitors. 6. Dielectrics in the electric field. Generalized Gauss's Law. Boundary conditions. 7. Energy and forces in the electrostatic field. Movement of a charged particle. 8. Electric current. Kirchhoff's first law. Specific resistance and conductivity. 9. Resistors. Ohm's and Joule's law. Resistor connections. Ground resistance. Electric generators and the term emp. 10. Simple circuit. Maximum power transmission condition. Potential and voltage. Equivalence of voltage and current generator. 11. Kirchhoff's second law. Direct application of Kirchhoff's laws for solving electrical networks. Method of contour currents. 12. Node potential method. Triangle-star equivalences and vice versa. Linearity theorem. 13. Reciprocity theorem. Thevenen's and Norton's theorem. Theorem of compensation. Theorem of power conservation in electrical. networks. 14. Special forms of electrical network. Elements of non-linear electrical network. Electrical networks with capacitors. 15. Electrostatic networks and Kirchhoff's laws. Energy balance in networks with capacitors.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
David J. Griffiths	Introduction to electrodynamics 3rd edition, Prentice Hall, Upper Saddle River, New Jersey 07458. ISBN 0-13-805326-X	1999	
Viktor Hacker, Christof Sumereder	Electrical Engineering: Fundamentals, De Gruyter Oldenbourg	2020	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Charles A. Gross, Thaddeus A. Roppel	Fundamentals of Electrical Engineering 1st Edition, CRC Press	2012	
Leonard S. Bobrow	Fundamentals of Electrical Engineering (The Oxford Series in Electrical and Computer Engineering) 2nd Edition, Oxford University Press	1996	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures	5	5%
	lab. exercises/practical work	15	15%
	midterm exam I	25	25%
	midterm exam II	25	25%
	Final exam	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / First year of study	

Full name of the course	**FUNDAMENTALS OF COMPUTER TECHNIQUE**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-004-1	compulsory	I	5,5

Teacher(s)	PhD Nikola Davidović, Assistant professor
Associate(s)	Marko Malović, Teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	0	2	52.5	0	52.5	1.75

total teaching workload (in hours, per semester) W= 2*15 + 0*15 + 2*15 =60 hours	total student workload (in hours, per semester) T= 2*15*So + 0*15*So + 2*15*So = 105 hours

Total workload of the subject (teaching + student): In_{opt}= W + T =60 + 105 = 165 hours per semester

Learning outcomes	By mastering this subject, the student will be able to: 1. To understand the basic mathematical and electronic foundations of computers, as well as to design switching networks with basic logic circuits. 2. To understand the architecture of the processor and the working principle of memory and peripheral units. 3. To understand the functions of system software, especially operating systems. 4. To understand the concepts of algorithm and program, as well as the principle of algorithm application in computer programs.
Prerequisites	No requirements.
Teaching methods	lectures, laboratory exercises
Subject content per weeks	1. Composition, general and hierarchical model of a computer system. 2. Mathematical basics of computers, conversion of numbers from decimal to other number systems and vice versa. 3. Arithmetic operations in the binary system, signed numbers, 1st and 2nd complement. 4. Floating point numbers, BCD numbers, ASCII code. 5. Electronic basics of computers, Boolean algebra, logical operations AND, OR and NOT. 6. Logic circuits, logic functions, minimization. 7. Combination networks, adder. Sequential networks, RS flip-flop. Registers, buses. 8. Memories, hierarchy of memory devices, 2D and 3D memories, RAM, ROM and stack memories. 9. Computer architecture, processor, data transfer. 10. Phases in instruction execution, obtaining and executing Load, Add and Store commands. 11. Types of instructions. 12. Addressing modes. 13. Data structures. Scalar data, arrays, data structures, lists, stores and queues. 14. Peripheral devices. Input and output devices. Mass storage, tapes, disks. 15. Operating systems, division and composition, processor management, memory, file system.
Compulsory literature	

Author(s)	Publication title, publisher	Year	Pages (from-to)
Obradović, S.	Fundamentals of Computer Engineering, VISER	2014.	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Stallings, W.	Computer organization and architecture	2013.	
Andrew Tanenbaum	Structured Computer Organization, Pearson	2013.	
Đorđević, Radivojević, Punt, Stanisavljević	Fundamentals of Computer Engineering, Akademska misao	2017.	

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5 %
	homework	5	5 %
	lab. exercises/practical work	10	10%
	midterm exam I	25	25 %
	midterm exam II	25	25 %
	final exam (written/oral)	30	30%
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / First year of study	

Full name of the course	**INTRODUCTION TO MANAGEMENT**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-005-1	compulsory	I	2

Teacher(s)	Nenad Marković, asst. prof.
Associate(s)	-

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	0	0	30	0	0	1

total teaching workload (in hours, per semester) W= 2*15= 30 h	total student workload (in hours, per semester) T= 2*15*S_o= 30 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 30 + 30 = 60 hours per semester

Learning outcomes	After successful completion of the course, student will be able to: 1. critically understand key management theories, concepts and principles, 2. application of the management function to solve problems, identify the manager's position in the organization, 3. understand the historical influence of management on today's management process, 4. understand the internal and external environment of the organization and its culture, 5. identify the steps in the decision-making process, 6. understand the impact of organizational strategy and organizational structure, 7. understand the importance of leadership, teamwork and human resource management, 8. anticipates the problems they will face during career development as managers or team members.
Prerequisites	-
Teaching methods	Presentations, Case studies
Subject content per weeks	1. Management 2. History of management 3. Organizational environment and culture 4. Planning and decision making 5. Organizational strategy 6. Organizational structure and design 7. Human resource management 8. Team management 9. COLLOQUIUM 10. Leadership 11. Communication management 12. Change and innovation management

	13. Control 14. Motivating employees 15. Managing operations

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Stephen P. Robbins, Mary Coulter	Management Prentice Hall, Eleventh edition	2012	-

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
David Boddy	Management – An Introduction Prentice Hall, Fifth Edition	2011	-

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	Activity and attendance at lectures	10	10%
	Midterm exam	39	39%
	final exam (written/oral)	51	51%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO **Faculty of Electrical Engineering**	
	Study program: *Computer Science and Informatics*	
	First study cycle / First year of study	

Full name of the course	**ENGLISH LANGUAGE 1**

Subject code	**Subject status**	**Semester**	**ECTS**
01-1-007-1	compulsory	I	2

Teacher(s)	Darko Kovačević, PhD, associate professor
Associate(s)	

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
1	1	-	15	15	-	1

total teaching workload (in hours, per semester) W=15 + 15 = 30	total student workload (in hours, per semester) T=15 + 15 = 30

Total workload of the subject (teaching + student): In_{opt}= W + T = 60 hours per semester

Learning outcomes	1. basic knowledge of morphology and syntax of the English language; 2. fundamentals of conversation related to general topics and general professional topics in electrical engineering; 3. ability to understand, translate and describe verbally and in writing text units written in English and related to general topics and general professional topics in electrical engineering 4. ability to create shorter text units related to general topics and general professional topics in electrical engineering
Prerequisites	There are no special requirements for taking courses and taking exams.
Teaching methods	method of demonstration, method of practical work, method of written work, method of reading and working on the text, method of conversation, method of oral presentation
Subject content per weeks	1. A Beginner's guide to Electrical Engineering. | Basic word order in English sentences (1). Present Simple Tense. Present Continuous Tense. 2. Electrical Laws and Theorems. | Basic word order in English sentences (2). Past Simple Tense. Past Continuous Tense. 3. Branches of Electrical Engineering. | Present Perfect Tense. Past Perfect Tense. 4. The History of the Smartphone. | Expressing Future. 5. The Importance of Computer Technology in Your Engineering Career | Nouns. 6. A Brief History of Automation | Pronouns. 7. A History of Automation: The Rise of Robots and AI. | Articles. 8. Computers - The Beginnings. | Adjectives and Adverbs. 9. The First and Second Generation of Computers. | Prepositions. . 10. What is Digital Technology? Different Types of Microcomputers. Differences between PLCs and Microcontrollers. | Conjunctions. 11. Augmented Reality. 12. Active and Passive Voice. 13. Augmented Intelligence. 14. Direct and Indirect Speech 15. Electrical Engineering: The 13 Most Influential Trends.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
M. Swan, C. Walker	A Good Grammar Book, Oxford University Press	1997	
D. Kovačević	English Language for Electrical Engineers 1: General Concepts | Faculty of Electrical Engineering of the University of East Sarajevo; Academic Mind	2021	

Additional literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	15	15 %
	positively evaluated seminar paper	5	5 %
	activity in lectures/exercises	10	10 %
	first test	20	20 %
	second test	20	20%
	Final examination		
	final examination (oral)	30	30 %
	TOTAL	100	100 %
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / First year of study	

Full name of the course	**MATHEMATICS 2**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-008-2	compulsory	II	7,0

Teacher(s)	Vidan Govedarica, PhD, full professor
Associate(s)	Vidan Govedarica, PhD, full professor; Nataša Pavlović Komazec, PhD, assistant professor

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
3	3	0	60	60	0	1.33

total teaching workload (in hours, per semester) W= 3*15 + 3*15 + 0*15 =90 h	total student workload (in hours, per semester) T= = 3*15*S_o + 3*15*S_o + 0*15*S_o = 120 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 90 + 120 = 210 hours per semester

Learning outcomes	By mastering this subject, the students will be able to: 1. build their thought structures, i.e. mathematical thinking, which is the carrier of every scientific endeavor, and especially of engineering creations 2. master the integrals of functions of one variable and their applications 3. master the differential calculus of functions of several variables 4. master curvilinear, multiple and surface integrals and their applications 5. master the methods for solving ordinary differential equations 6. uses acquired knowledge in professional subjects.
Prerequisites	There are no special requirements for taking courses and taking exams.
Teaching methods	The teaching process is realized mainly through a frontal form of work - lectures and an interactive form of work - auditory exercises.
Subject content per weeks	1. The problem of calculating the area and the definition of the definite integral. Properties of integrable functions. 2. Primitive function and indefinite integral. The connection between the definite and the indefinite integral. Newton-Leibnitz formula. 3. Methods of integration. Improper integrals. 4. Integration of rational, irrational and trigonometric functions. Integrals that are not elementary functions. Applications of the definite integral. 5. Metric spaces. Functions of multiple variables. Convergence and continuity. 6. Differentiability of functions of several variables. Necessary and sufficient conditions of differentiability. Differentials of higher order and Taylor's formula. 7. Concept of mapping. Jacobian determinant. Implicit functions. The notion of a local extreme and the necessary conditions for its existence. 8. Sufficient conditions for the existence of a local extreme. Sylvester's criterion. Conditional extremes. 9. Curvilinear integrals by coordinates. Curvilinear arc integrals. 10. The concept of multiple integrals. Double integrals. Triple integrals. 11. Change of variables in multiple integrals. Green-Riemann theorem.

	12. Surface integrals by coordinates. Surface integrals per surface area. Stokes theorem and Ostrogradsky. 13. Scalar and vector field. Divergence and rotor. Classification of vector fields. 14. Ordinary differential equations. Differential equations of the first order. 15. Linear differential equations of higher order. Differential equations with constant coefficients. Euler's equation.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
R. Courant	Differential and integral calculus, Vol. I, Ishi Press	2010	-
Y. Zou	Multi-variable calculus – A first step, De Gruyter	2020	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Wei-Chau Xie	Differential equations for engineers, Cambridge University Press	2010	-
A. K. Sharma	Text book of multiple integrals, Discovery Publishing House	2005	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	Activity and attendance at lectures	10	10%
	midterm exam I	30	30%
	midterm exam II	30	30%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle | First year of study	

Full name of the course	**INTRODUCTION TO PROGRAMMING**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-009-2	compulsory	II	5,5

Teacher(s)	Snježana Milinković, PhD, assistant professor
Associate(s)	Zorana Štaka, MSc, senior teaching assistant; Marko Malović, BSc, teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	2	36	18	36	1.2

total teaching workload (in hours, per semester) W= 2*15 + 1*15 + 2*15 =75 h	total student workload (in hours, per semester) T= = 2*15*S_o + 1*15*S_o + 2*15*S_o = 90 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 75 + 90 = 165 hours per semester

Learning outcomes	By mastering this subject, the students will: 1. be capable of independent algorithmic solving of programming problems of low or medium complexity 2. be able to work with software development tools in the C programming language 3. be able to implement algorithmically solved problems in the C programming language 4. be able to use function modules of low or medium complexity in the C programming language.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge from the subject: Fundamentals of computer technique.
Teaching methods	Lectures, auditory exercises, laboratory exercises, knowledge verification tests, homeworks.
Subject content per weeks	1. Introduction to general programming fundamentals. Algorithms. 2. C program structure. Basic data types in the C programming language. Variables, declaration, format specifications. 3. Data input and output (printf, scanf). 4. Program development process: editing, compiling, linking, testing and debugging. 5. Preprocessor directives. Comments. Casting. 6. Operators in C. 7. Control flow: sequence. 8. Control flow: selection. 9. Control flow: iteration (loops). 10. Control flow: nested loops. 11. Arrays – General concepts. 12. 1D arrays of numbers. 13. 2D arrays of numbers. 14. Algorithms for working with 1D and 2D arrays. 15. Strings. U-I conversion. Strings functions.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

K. N. King	C Programming: A Modern Approach, W. W. Norton & Company, 2nd Edition	2008	-

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Kernighan, B.W., Ritchie, D.M.	Programming language C, Prentice Hall, Second edition	1988	-

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	defense of laboratory exercises	15	15%
	knowledge verification tests	10	10%
	class activities (optional)	4	4%
	homework assignments (optional)	4	4%
	midterm exam I (optional)	25	25%
	midterm exam II (optional)	45	45%
	final exam (written/oral)	70	70%
	TOTAL	108	108%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / First year of study	
Full name of the course	**FUNDAMENTALS OF ELECTRICAL ENGINEERING – 2**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-010-2	Compulsory	II	7.0

Teacher(s)	PhD Srđan Lale, assistant professor
Associate(s)	MA Bojana Čolić, BA Zorana Mandić

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
3	2	1	60	40	20	1.33

total teaching workload (in hours, per semester) W= 3*15 + 2*15 + 1*15 =90 hours	total student workload (in hours, per semester) T= 3*15*So + 2*15*So + 1*15*So = 120 hours

Total workload of the subject (teaching + student): Inopt= W+T=Uopt= 90 + 120 = 210 hours per semester

Learning outcomes	By mastering this subject, the student will be able to: 1. Explain the basic concepts and laws of electromagnetism and time-varying currents, 2. Calculates magnetic force, induction, flux, magnetic field and magnetic energy, 3. Determine the expression for inductance and intermediate inductance of different contours, 4. Apply Faraday's law and Kirchhoff's law to the calculation of magnetic circuits, 5. Distinguish general equations of electrical networks with time-varying currents and simple periodic currents, 6. Apply the phasor and complex calculus for solving simple periodic current circuits, 7. Explain the basic concepts of symmetrical three-phase systems and the ways of forming a rotating magnetic field, 8. Use the knowledge of this subject in the following subjects of electrical engineering studies.
Prerequisites	There are no requirements for registering and listening to the subject.
Teaching methods	Lectures (with with the use of modern audiovisual equipment), auditory exercises and laboratory exercises. Students also receive homework.
Subject content per weeks	1. Electromagnetic force. Magnetic field and vector of magnetic induction. Bio-Savar's law. 2. Magnetic induction vector flux and the law of conservation of magnetic flux. The movement of the charged particle in the electr. and magn. field. Hall effect. 3. Ampere's law. Basic concepts about the magnetic properties of matter. Generalized Ampere's law. 4. Boundary conditions. Kirchhoff's laws for magnetic circuits. 5. Calculation methods. Permanent magnet magnetic circuit. Dielectrics in the electric field. Generalized Gauss's Law. Boundary conditions. 6. Induced electric field. Faraday's law electromag. induction. Eddy currents, surface effect and proximity effect. Inductances. Measurement of magnetic induction. Flow equation. 7. Energy and forces in the magnetic field. General method of calculating magnetic forces.

	8. General equations of electricity. network with time-varying currents. Generalized Kirchhoff laws. 9. Periodic and simple periodic quantities. Mean and effective value. Basic passive elements in the periodic regime. Rotating vectors. 10. Phasor diagrams. Resonance and anti-resonance. Active and reactive power. Power factor. 11. Kirchhoff's laws in complex form. Impedance and admittance. Equivalences. 12. Methods and theorems in complex form. Simply resonant and anti-resonant circuit. Transformers. 13. Polyphase and three-phase systems, generators and receivers. 14. Two-phase and three-phase rotating mag. field. Basic concepts of synchronous and asynchronous motor. 15. Frequency dependencies. Resonance and anti-resonance phenomena in more complex networks. R, L and C at high frequencies.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
David J. Griffiths	Introduction to electrodynamics 3rd edition, Prentice Hall, Upper Saddle River, New Jersey 07458. ISBN 0-13-805326-X	1999	
Viktor Hacker, Christof Sumereder	Electrical Engineering: Fundamentals, De Gruyter Oldenbourg	2020	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Charles A. Gross, Thaddeus A. Roppel	Fundamentals of Electrical Engineering 1st Edition, CRC Press	2012	
Leonard S. Bobrow	Fundamentals of Electrical Engineering (The Oxford Series in Electrical and Computer Engineering) 2nd Edition, Oxford University Press	1996	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures	5	5%
	lab. exercises/practical work	15	15%
	midterm exam I	25	25%
	midterm exam II	25	25%
	Final exam	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Firstyear of study	

Full name of the course	**PHYSICAL FUNDAMENTALS OF ELECTRONICS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-011-2	compulsory	II	5,5

Teacher(s)	Dr Zoran Ljuboje, full professor
Associate(s)	Vesna Miletic, msc

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	0	52.5	52.5	0	1.75

total teaching workload (in hours, per semester) W=2*15 + 2*15 +0*15 = 60 h	total student workload (in hours, per semester) T= 2*15*S_o + 2*15*S_o + 0*15* S_o = 105 h

Total workload of the subject (teaching + student): In_{opt}= 60 + 105 = 165 hours per semester

Learning outcomes	1. Introducing students to the basics of atomic and quantum physics from the aspect of electronics development 2. Introduction to the electronic theory of metals and the zone theory of solids. 3. Getting to know the properties of semiconductors, contact phenomena and optoelectronics.
Prerequisites	There are no requirements for listening and passing the course.
Teaching methods	Lectures, auditory exercises, seminar papers.
Subject content per weeks	1. Introduction. Introduction to atomic physics. Movement of electrons in electric and magnetic fields. 2. Milliken's experiment. Absolute blackbody radiation. 3. Photoelectric effect. X-ray radiation. 4. Model of the atom. Bohr's model of the atom. 5. Introduction to quantum mechanics. Wave properties of a particle. The Schrödinger equation. 6. Tunnel effect. Heisenberg's uncertainty principle. 7. Quantum mechanical model of the atom. 8. Electronic theory of metals. Fermi-Dirac distribution function. 9. Distribution of electrons by momentum and energy. Electrical conductivity of metals. 10. Zone theory of solids. Strong link approximation. Weak link approximation 11. Effective mass of electrons. 12. Semiconductors. Specific conductivity of own and mixed semiconductors. 13. Current density equation for semiconductors. Hall effect. 14. Contact phenomena. Metal-semiconductor contact. Busbar contact, p-n contact. 15. Introduction to optoelectronics. Photoresistors. Photodiodes. LEDs. Lasers.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Zoran Ljuboje	Fizički osnovi elektronike, ETF, Univerzitet u Istočnom Sarajevu	2016.	3.-145.
G. I. Epifanov	Fizika čvrstog stanja, prevod ETF Sarajevo	1969.	8.-38., 147.-298.

Ž. Pržulj, Z. Ljuboje, Z. Ivić	Zbirka riješenih zadataka iz fizike čvrstog stanja, ETF, Univerzitet u Istočnom Sarajevu	2016.	7.-29., 121.-197.

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	midterm exam I	20	20%
	midterm exam II	20	20%
	test and seminar papers	15	15%
	final exam (written/oral)	40	40%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering ***Study program:*** *Computer Science and Informatics* First study cycle | First year of study	

Full name of the course	**APPLICATION SOFTWARE**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-012-2	compulsory	II	3,0

Teacher(s)	dr Marijana Ćosović, assistant professor
Associate(s)	dr Nikola Davidović, assistant professor

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
0	0	2	0	0	60	2

total teaching workload (in hours, per semester) W= 0*15 + 0*15 + 0*15 =30 h	total student workload (in hours, per semester) T= 0*15*S_o + 0*15*S_o + 2*15*S_o = 60 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 30 + 60 = 90 hours per semester

Learning outcomes	1. To understand the way a computer works, as well as to know the basic parts and programs necessary for its functioning. 2. To create and edit text documents using the tools offered by the word processing program. 3. To use and edit tabular documents in work. 4. To use various calculation operations by entering mathematical and logical formulas offered by the program for processing tabular calculations. 5. To create and edit a presentation using the tools offered by the program for creating presentations.
Prerequisites	There are no requirements for registering and listening to the course.
Teaching methods	Laboratory exercises
Subject content per weeks	1. Word processors. Working environment: menu, submenus. 2. Saving and exiting the program. Opening a saved document. 3. Text marking (copying, moving, deleting, clipboard - concept). 4. Paragraph (meaning: paragraph mark, procedures: insert, split, join). Paragraph editing 5. Programs for working with tables and spreadsheet calculations (concept). Starting up. 6. Working environment. Workbook, worksheet (comparison Word: document, page). 7. Cell, data entry, movement. Editing the contents of a cell. 8. Insertion, deletion: rows and columns; cell contents. Cell formatting. 9. Changing column width and row height. Work with worksheets. 10. Calculation using formulas. Copying formulas, absolute and relative addressing. Functions concept. Using the Help and Wizard. 11. Programs for creating presentations (concept). Starting up. Work environment. Help. Opening, recording, closing, finding documents. 12. Working with presentation pages in different views. 13. Inserting, deleting, and copying slides. Text input. Change the appearance of the text. 14. Entry of images and other objects. Formatting objects. Adding a diagram.

	15. Internet. Client-server architecture. Programs for working with electronic mail.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
J. Lambert, C. Frye	Microsoft Office Step by Step (Office 2021 and Microsoft 365)	2022	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5 %
	homework	5	5 %
	midterm exams	60	60 %
	final exam (written/oral)	30	30 %
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO **Faculty of Electrical Engineering**	
	Study program: *Computer Science and Informatics*	
	First study cycle / First year of study	

Full name of the course	**ENGLISH LANGUAGE 2**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-013-2	compulsory	II	2

Teacher(s)	Darko Kovačević, PhD, associate professor
Associate(s)	

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
1	1	-	15	15	-	1

total teaching workload (in hours, per semester) W=15 + 15 = 30	total student workload (in hours, per semester) T=15 + 15 = 30

Total workload of the subject (teaching + student): In_{opt}= W + T = 60 hours per semester

Learning outcomes	1. basic knowledge of morphology and syntax of the English language; 2. familiarization with terminology from different areas of information and communication technologies; 3. fundamentals of conversation related to general topics and general professional topics in electrical engineering; 4. ability to understand, translate and describe verbally and in writing text units written in English and related to general topics and general professional topics in electrical engineering 5. ability to create shorter text units related to general topics and general professional topics in electrical engineering
Prerequisites	There are no special requirements for taking courses and taking exams.
Teaching methods	method of demonstration, method of practical work, method of written work, method of reading and working on the text, method of conversation, method of oral presentation
Subject content per weeks	1. How computers changed the world. The effect of cyberbullying on children. | Modal verbs (1) 2. What is a computer? | Modal verbs (2) 3. Peripherals you can use with your computer. | Modal verbs (3) 4. Inside a computer. | Conditional sentences (type 0 and 1) 5. Computing and health. | Conditional sentences (type 2) 6. What is an operating system. | Conditional sentences (type 3) 7. The software development cycle. Application | Mixed conditionals 8. What is graphics software? 9. Multimedia. 10. Programming languages. | Verbals: Participle 11. A day in the life of a computer operator/programmer | Verbals: Gerund 12. Computer network types. | Verbals: Infinitive 13. Computer network architecture. Network topology | Gerund and Infinitive 14. What are the advantages of the Internet? 15. Benefits of the Internet and social media.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
M. Swan, C. Walker	A Good Grammar Book, Oxford University Press	1997	
D. Kovačević	English Language for Electrical Engineers 2: ICT | Faculty of Electrical Engineering of the University of East Sarajevo; Academic Mind	2021	

Additional literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
S. R, Esteras & E. M. Fabre	Professional English in Use: ICT, Cambridge University Press	2007	1-67

	Type of student work evaluation	**Points**	**Percentage**

Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	15	15 %
	positively evaluated seminar paper	5	5 %
	activity in lectures/exercises	10	10 %
	first test	20	20 %
	second test	20	20%
	Final examination		
	final examination (oral)	30	30 %
	TOTAL	100	100 %
Certification date			

SECOND YEAR

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Second year of study	

Full name of the course	**MATHEMATICS 3**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-008-2	compulsory	III	6,0

Teacher(s)	Vidan Govedarica, PhD, full professor
Associate(s)	Milica Bošković, MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
3	2	0	63	42	0	1.4

total teaching workload (in hours, per semester) W= 3*15 + 2*15 + 0*15 =75 h	total student workload (in hours, per semester) T= = 3*15*S_o + 2*15*S_o + 0*15*S_o = 105 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 75 + 105 = 180 hours per semester

Learning outcomes	By mastering this subject, the students will be able to: 1. master the theory of degrees and Fourier series and their applications 2. solve systems of differential equations 3. master the theory of functions of a complex variable 4. master the Laplace transform and its applications 5. use acquired knowledge in professional subjects.
Prerequisites	There are no special requirements for taking courses and taking exams.
Teaching methods	The teaching process is realized mainly through a frontal form of work - lectures and an interactive form of work - auditory exercises.
Subject content per weeks	1. Numerical series. 2. Uniform convergence of series of functions. Uniform convergence of series. 3. Graded series. Differentiation and power-order integration. Maclauren's series. 4. Systems of orthogonal functions. Generalized Fourier series. Bessel's inequality and Parseval's equality. Trigonometric series. 5. Fourier series. Convergence of the Fourier series. Dirichlet's theorem. Fourier integral and Fourier transform. 6. Gamma and beta functions. Solving differential equations using series. Bessel differential equation and Bessel functions. 7. Systems of ordinary differential equations. Systems of linear differential equations. 8. The concept of a function of a complex variable. Continuity and derivative. Cauchy-Riemann conditions. 9. Conformal mapping. Bilinear function. 10. Elementary functions of the Cauchy-Gursa integral theorem. 11. Cauchy's basic integral formula. Applications of Cauchy's basic integral formula. 12. Taylor's and Laurent's series. Singularities of analytical functions. The concept of residue and Cauchy's theorem on residues. 13. The concept of Laplace transform. Properties of the Laplace transform.

	14. Convolution of functions. Inverse Laplace transform and applications of Laplace transform. 15. Concept of partial differential equation. Partial equations of the first order. Equations of mathematical physics.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
R. Magnus	Fundamental mathematical analysis, Springer	2020	-
R. H. Dyer, D. E. Edmunds	From real to complex analysis, Springer	2014	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
P. Dyke	An introduction to Laplace transforms and Fourier series, Springer	2014	-
R. P. Agarwal, K. Perera, S. Pinelas	An introduction to complex analysis, Springer	2011	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	Activity and attendance at lectures	10	10%
	midterm exam I	30	30%
	midterm exam II	30	30%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Second year of study	
Full name of the course	**ELECTRIC CIRCUITS THEORY – 1**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-015-3	compulsory	III	5,0

Teacher(s)	Srđan Lale, PhD, assistant professor
Associate(s)	Marko Ikić, MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	0	45	45	0	1.5

total teaching workload (in hours, per semester) W= 2*15 + 2*15 + 0*15 =60 h	total student workload (in hours, per semester) T= = 2*15*S_o + 2*15*S_o + 0*15*S_o = 90 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 60 + 90 = 150 hours per semester

Learning outcomes	Knowledge and skills are acquired for: 1. study of various physical and non-physical phenomena based on the terms model, element, characteristic. 2. analysis of electrical circuits in the frequency domain. 3. analysis of elements with two approaches (quadrupoles) as basic units of transmission systems. 4. understanding and application of the elementary theory of reactive electrical filters.
Prerequisites	There are no requirements for registering and listening to the course. Required prerequisites: Fundamentals of electrical engineering 1 and 2, Mathematics 1, 2, 3, Physics.
Teaching methods	Teaching is conducted in the form of lectures, auditory exercises and demonstration exercises on the computer. Learning, tests, assignments and consultations.
Subject content per weeks	1. Introduction. Electric circuit. Electric circuit element, characteristic of the element, division. 2. Single access elements, resistor, capacitor, inductor. 3. Elements with multiple accesses, coupled inductors, controlled voltage and current source. 4. Multi-access elements, impedance converter, gyrator, ideal and real operational amplifier. 5. Harmonic analysis of circuits with periodic nonsinusoidal sources. Representation of a periodic nonsinusoidal function using simple periodic functions. 6. Spectral analysis of a complex periodic function. Application of Fourier's series. The mean and effective value of a complex periodic quantity. 7. Factors that characterize the shape of the complex periodic curve. Power calculation. 8. Introduction to passive reciprocal networks with two approaches (quadrupoles). 9. Different systems of quadrupole equations, primary parameters. 10. Input impedances and four-pole transfer functions. Secondary parameters. 11. T and Pi quadrupole, gamma and reverse gamma quadrupole.

	12. Series, parallel and cascade connection of quadrupoles. 13. Elementary filter theory, filter cascade. General procedure for determining the bandwidth of symmetrical reactive filters. 14. K-filters LPF, HPF, bandpass and non-bandpass filters. Disadvantages of K-filters. 15. Filters with derived cells. Eliminating the shortcomings of K-filters, filter chains.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
R. C. Dorf, J. A. Svoboda	Introduction to Electric Circuits, 9th Edition, Wiley	2013	-
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
D. P. Kanoussis	Introduction to electric circuits theory, Vol. 1 (The electrical engineering series)	2017	-
C. P. Steinmetz	Theory and calculation of electric circuits, Watchmaker Publishing	2010	-

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10%
	midterm exam I	30	30%
	midterm exam II	30	30%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle | Second year of study	

Full name of the course	**ELECTRICAL MEASUREMENTS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-016-3	compulsory	III	5,0

Teacher(s)	asst. professor PhD Miodrag Forcan
Associate(s)	asst. professor PhD Miodrag Forcan, asst. MA Goran Vuković, asst. MA Nikola Kukrić

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	0	2	45	0	45	1.5

total teaching workload (in hours, per semester) W= 2*15 + 0*15 + 2*15 =60 h	total student workload (in hours, per semester) T= = 2*15*S_o + 0*15*S_o + 2*15*S_o = 90 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 60 + 90 = 150 hours per semester

Learning outcomes	1. Basic knowledge of metrology and standards of electrical measuring quantities. 2. Basic knowledge of measurement systems and statistical analysis of the measuring results. 3. Basic knowledge of measuring instruments, signal generators, sensors and transducers. 4. Basic knowledge of measuring methods, measurement-information technology, and measurement information systems. 5. Basic knowledge of measuring electrical and non-electric quantities.
Prerequisites	There is no conditionality related to other subjects (no prerequizites).
Teaching methods	Lectures(L), laboratory classes/exercises (LE).
Subject content per weeks	1. Introduction. Metrology, measurement standards, measurement traceability, and calibration hierarchy. 2. International System of Quantities (ISQ) and International System of Units (SI). Realization of SI units for electrical quantities. 3. Measurement errors and statistical analysis of the measuring results. Measurement uncertainty. 4. Measuring instruments. Instrument types and performance characteristics. 5. Electronic instruments. Data acquisition and signal processing systems. 6. Recording, storage, and display devices. Oscilloscopes. 7. Signal generators and analysers. 8. Measurement of resistance, inductance, and capacitance. 9. Measurement bridges and compensators. 10. Measurement of power and energy. Smart electricity meters. 11. Instrument transformers. 12. Sensors and transducers. 13. Measurement of non-electric quantities. Measurement of temperature. 14. Measurement reliability and safety systems. 15. Measurement-information technology and measurement information systems.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Prithwiraj Purkait, Budhaditya Biswas, Santanu Das, Chiranjib Koley	Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education, New Delhi.	2013	-
Alan S. Morris, Reza Langari.	Measurement and Instrumentation - Theory and Application, Academic Press - Elsevier.	2016	
V. Radenković, V. Milenković	Električna mjerenja, EF Niš, ETF I. Sarajevo	2004	
S. Damjanović, M. Banjanin, M. Ćosović, M. Forcan	Praktikum za laboratorijske vježbe iz električnih mjerenja, ETF I. Sarajevo	2016	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
			-

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	I partial exam (colloquia)	20	20%
	II partial exam (colloquia)	20	20%
	laboratory exercises	15	15%
	seminar paper	10	10%
	Final exam		
	test paper	15	15%
	oral examination	15	15%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	Firs study cycle / Second year of study	

Full name of the course	**ELECTRONICS 1**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-017-3	compulsory	III	6

Teacher(s)	PhD Božidar Popović, Associate Professor
Associate(s)	MSc Goran Vuković

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
3	2	1	45	30	15	1

total teaching workload (in hours, per semester) W=3*15 + 2*15 + 1*15 = 90 h	total student workload (in hours, per semester) T=3*15*S_o + 2*15*S_o + 1*15*S_o = 90 h

Total workload of the subject (teaching + student): In_{opt}= W + T = = 90 + 90 = 180 hours per semester

Learning outcomes	By mastering this subject, the student will be able to: 1. Understanding and analyzing the operation of semiconductor diodes, making correct conclusions about polarization, ways and conditions of operation. 2. Understanding and analysis of bipolar transistor operation, making correct conclusions about polarization, methods and conditions of operation. 3. Understanding and analyzing the operation of unipolar transistors, making correct conclusions about polarization, methods and conditions of operation. 4. Understanding and knowledge of the basic concepts of operation and ways of connecting individual components in analog and digital electronic circuits. 5. Understanding, defining, analyzing, discussing and solving problems, tasks related to the operation of electronic components in direct current and alternating mode. 4. Understanding the principles of operation and analysis of single-stage amplifier circuits (BJT, JFET, MOSFET).
Prerequisites	No prerequisites.
Teaching methods	Lectures, auditory exercises, laboratory exercises
Subject content per weeks	1. Student obligations and assessment. Current-voltage characteristics of diodes, threshold voltage, static and dynamic resistance (ideal and real diodes). 2.Analysis of diode operation in direct polarization and inverse polarization (operating point, temperature dependence, capacitance). 3. Rectifiers, switches, Schottky diodes, Zener diodes, LEDs, photodiodes, Rectifier circuits with diodes. 4. Analysis of bipolar transistor (BJT) operation. Static characteristics of the bipolar transistor. Fields of operation of BJT transistors. 5. Determination of the operating point of the BJT transistor. Temperature stabilization of circuits with BJT transistors. 6. Polarization of BJT. Polarization of parallel connected BJTs. Limitations in the operation of BJT transistors.

	7. Ebers-Moll model of a bipolar transistor. Equivalent PI circuit of BJT transistor for small signals. Equivalent circuit of BJT transistor for small signals. TTL - logic circuit (inverting circuit). DTL - logic circuits (AND, OR, NOT, NOR). 8. JFET operation analysis. Static characteristic of JFET. Limitations in JFET operation 9. Polarization of JFET. Equivalent to the small signal circuit of the JFET. JFET in switching mode. 10. Analysis of operation of MOSFET with built-in channel. Static characteristics of embedded channel MOSFETs. Limitations in MOSFET operation. Analysis of MOSFET operation with an induced channel. 11. Static characteristics of MOSFET with an induced channel. Vertical MOSFET - VMOS, CMOS. Polarization of MOSFETs (built-in, induced channel). Equivalent to the MOSFET small-signal circuit. 12. Features of the amplifier. Single stage amplifiers. Analysis of AC-coupled amplifier with bipolar transistor in connection with ZE, ZB, ZC. 13. Analysis of an AC-coupled amplifier with a JFET coupled with ZS, ZG, ZD, Analysis of an AC-coupled amplifier. 14. Two-stage amplifier. Amplifiers with direct coupling-level shifters (with Zener diode, with transistor). Darlington configuration and cascode amplifier. Amplitude and phase characteristics of the amplifier - Bode diagrams. 15. Phototransistor. Optocoupler. IGBT. Thyristor and other semiconductor components from the same family.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
G. McWhorter, A. J. Evans	Basic Electronics, Master Publishing, Inc.	2004	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
A. S. Sedra, K. C. Smith	Microelectronics Circuits, Sounders College Publishing	1991	

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	midterm exams	35	35%
	lab. exercises/practical work	10	10%
	final exam (written/oral)	50	50%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Second year of study	
Full name of the course	**PROGRAMMING LANGUAGES**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-018-3	compulsory	III	6,0

Teacher(s)	Snježana Milinković, PhD, assistant professor
Associate(s)	Miljan Sikimić, MSc, senior teaching assistant; Zorana Štaka, MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	60	30	30	2

total teaching workload (in hours, per semester) W= 2*15 + 1*15 + 1*15 =60 h	total student workload (in hours, per semester) T= = 2*15*S_o + 1*15*S_o + 1*15*S_o = 120 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 60 + 120 = 180 hours per semester

Learning outcomes	By mastering this subject, the student will: 1. understand advanced programming concepts in procedural programming languages, 2. be capable of practical implementation of advanced concepts of procedural programming in the programming language C, 3. be able to implement and test more complex programs in the C language using static and dynamic data structures, 4. be able to implement and test more complex programs in the C language using advanced concepts in working with functions.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge from the subjects: Fundamentals of computer technique, Introduction to programming.
Teaching methods	Lectures, auditory exercises, laboratory exercises, knowledge verification tests.
Subject content per weeks	1. Introduction. Chronology of development and characteristics of programming languages. 2. Classification of programming languages. 3. Syntax of programming languages. Formal syntax description. 4. Data types concept. 5. Pointers in C. 6. Advanced data types. 7. Dynamic memory allocation. Implementing arrays in a dynamic memory area in C programming language. 8. Subprograms – general concepts. Functions and procedures. Functions in C. 9. Transfer of arguments. Recursion.Memory classes. 10. Structures in C. 11. Union in C. 12. Files – general concepts.

	13. Input/output, text and binary files in C programming language. 14. Dynamic data structures. 15. Internet and web technologies - basic concepts.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Kernighan, B.W., Ritchie, D.M.	Programming language C, Prentice Hall, Second edition	1988	-

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
B. C. Pierce	Types and Programming Languages, The MIT Press	2002	-

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	defense of laboratory exercises	15	15%
	knowledge verification tests	10	10%
	midterm exam I (optional)	35	35%
	midterm exam II (optional)	35	35%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO **Faculty of Electrical Engineering**	
	Study program: *Computer Science and Informatics*	
	First study cycle / Second year of study	

Full name of the course	**ENGLISH LANGUAGE 3**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-019-3	compulsory	III	2

Teacher(s)	Darko Kovačević, PhD, associate professor
Associate(s)	

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
1	1	-	15	15	-	1

total teaching workload (in hours, per semester) W=1*15 + 1*15 + 0*15= 30 h	total student workload (in hours, per semester) T=1*15*S_o + 1*15*S_o + 0*15*S_o = 30 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 30 + 30 = 60 hours per semester

Learning outcomes	1. familiarization with the characteristic language constructions related to the use of the English language in technical sciences, with special reference to the discourse of electrical engineering and information and communication technologies. 2. familiarization with terminology in English from various fields of technical sciences, with special reference to the discourse of electrical engineering and information and communication technologies; 3. advanced conversation related to various areas and topics related to technical sciences, with special reference to areas and topics from electrical engineering and information and communication technologies; 4. familiarization with terminology and ways of textual presentation of information related to the historical development of various phenomena, devices and inventions important for electrical engineering and information and communication technologies; 5. ability of understanding, translation and verbal and written description of textual units written in English and related to technical sciences, with an emphasis on electrical engineering and information and communication technologies; 6. ability to create text units related to technical sciences, with an emphasis on electrical engineering and information and communication technologies.
Prerequisites	There are no special requirements for taking courses and taking exams.
Teaching methods	method of demonstration, method of practical work, method of written work, method of reading and working on the text, method of conversation, method of oral presentation
Subject content per weeks	1. Electricity Transmission. 2. A Brief History of Hydroelectricity. 3. History of Telephone. 4. History of Fiber Optics. 5. The History and Development of Batteries. 6. The History of Electric Motor Technology: a Journey through Time. 7. A Brief History of Programming: Why Functional Programming Matters? 8. A Brief History of the Early Internet. 9. The History of the Integrated Circuit. 10. Microprocessor History and Background. 11. A Brief History of Embedded Systems: Computer Hardware and Software. 12. A Brief History of Embedded Systems: Networking and IoT 13. A Brief History of Embedded Systems: Cloud, DC and SDN. 14. History and Origins of Magnetism. 15. The History of Digitalisierung in Five Phases.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

D. Kovačević	Collection of texts for English Language 3 with exercises and assignments	2020	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	attendance at lectures/exercises	15	15 %
	positively evaluated seminar paper	5	5 %
	activity in lectures/exercises	10	10 %
	first test	20	20 %
	second test	20	20%
	Final examination		
	final examination (oral)	30	30 %
	TOTAL	100	100 %
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Second year of study	

Full name of the course	**NUMERICAL MATHEMATICS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-020-4	compulsory	IV	6.0

Teacher	Assistant Professor Nataša Pavlović Komazec
Associate	Assistant Professor Nataša Pavlović Komazec

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	3	0	42	63	0	1.4

total teaching workload (in hours, per semester) W= 2*15 + 3*15 + 0*15 =75 hours	total student workload (in hours, per semester) T= $2*15*S_o + 3*15*S_o + 0*15*S_o$ = 105 hours

Total workload of the subject (teaching + student): In_{opt}= W + T = 75 + 105=180 hours per semester

Learning outcomes	By mastering this subject, the student will be able to: 1. master the numerical methods of solving nonlinear equations and systems 2. master various types of interpolation of functions and their applications 3. knows the methods of numerical integration 4. master various types of approximation of functions 5. knows the methods for numerical solution of ODE 6. uses acquired knowledge in professional subjects
Prerequisites	There are no requirements for listening
Teaching methods	The teaching process is realized mainly through a frontal form of work - lectures and an interactive form of work - auditory exercises.
Subject content per weeks	1. Introduction to Numerical Mathematics. Error Analysis. 2. Nonlinear Equations. Localization of the solution of the equation. Bisection Method. 3. Fixed-Point Iteration Method. 4. Secant Method. Newton's Method. 5. Linear Systems. Matrix Norm. Direct methods. Iterative methods. Jacobi and Gauss Seidel Method. 6. Eigenvalues and Eigenvectors. Leverrier Method, Krylov Method. 7. Interpolation by Polynomials. Lagrange Interpolation. 8. Newton Interpolation and Divide Differences. Interpolation Using Equally Spaced Points. Trigonometric Interpolation. 9. Piecewise Linear and Cubic Spline Interpolation. Inverse interpolation. 10. Numerical Differentiation. 11. Numerical Integration. Newton–Cotes quadrature formulas. 12. Quadrature Formulas of Gaussian Type. Orthogonal Polynomials 13. Approximation of functions. Mean Square Approximation. The Method of Least Squares. Uniform Approximation. 14. Numerical Ordinary Differential Equations. Euler's Method. Runge-Kutta Methods. 15. Boundary Value Problems of Ordinary Differential Equations. Finite Difference Methods. Shooting Methods.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

K. E. Atkinson	An Introduction to Numerical Analysis (2nd edition), Wiley	1989.	
S. D. Conte, Carl de Boor	Elementary Numerical Analysis - An Algorithmic Approach (3rd edition), McGraw-Hill	1981.	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Parviz Moin	Fundamentals of Engineering Numerical Analysis, Cambridge University Press	2010.	
R. W. Hamming	Numerical Methods for Scientists and Engineers, Dover Publications	1986.	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	homework	5	5%
	midterm exam I	30	30%
	midterm exam II	30	30%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Second year of study	
Full name of the course	**ELECTRIC CIRCUITS THEORY – 2**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-021-4	compulsory	IV	5,0

Teacher(s)	Srđan Lale, PhD, assistant professor
Associate(s)	Marko Ikić, MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	45	22.5	22.5	1.5

total teaching workload (in hours, per semester) W= 2*15 + 1*15 + 1*15 =60 h	total student workload (in hours, per semester) T= = 2*15*S_o + 1*15*S_o + 1*15*S_o = 90 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 60 + 90 = 150 hours per semester

Learning outcomes	Knowledge and skills are acquired for: 1. Study of electric circuits with time-space characteristics (electric circuits with distributed parameters, telegrapher's equations). 2. Analysis of electrical circuits in the time domain. State space and state equations. Analogies with similar dynamic systems. 3. Analysis of electrical circuits in the complex domain. Laplace transform. An example of the behavior of simple practical circuits during the transient process. 4. Studying the topology of electric circuits. Introduction to graph theory. Matrix methods for the analysis of electrical circuits. Computer methods for the analysis of electrical circuits. Work with self-developed software packages and professional package PSPICE.
Prerequisites	There are no requirements for registering and listening to the course. Required prerequisites: Fundamentals of electrical engineering 1 and 2, Mathematics 1, 2, 3, Numerical mathematics, Physics.
Teaching methods	Teaching is conducted in the form of lectures, auditory exercises and demonstration exercises on the computer. Learning, tests, assignments and consultations.
Subject content per weeks	1. Analysis of circuits with distributed parameters. Telegrapher's equations. 2. Propagation equations in the stationary state for the case of a simple periodic source. Propagation constant and characteristic impedance. 3. Representation of the stationary mode using traveling waves. Factor of voltage and current reflection. Line closed by impedance. 4. Line without distortion. Lossless line, quarter-wave transformer. Short-circuited and open line without losses, occurrence of standing waves and resonance. 5. Analysis of electrical circuits in the time domain. State sizes and state space. 6. Equations of state, independent initial conditions. Solving the equation of state, classical method. 7. Circuits of the first order, response of the circuit to a constant and simple periodic excitation function. Application of computers for solving equations of state of higher order.

	8. Integral transformations for the analysis of electric circuits. Ohm's law in the operational area. 9. Equivalent circuit method in the s-domain. Thevenen's and Norton's theorem in the s-domain. 10. Superpositional integrals in the analysis of electric circuits. Network functions. 11. Diamel's and convolutional integral for determining the response of an electric circuit. 12. Basic concepts from graph theory, subgraphs, path, contour, tree, section. 13. Topological matrices of circuits. Interrelationships of topological matrices of circuits. 14. Basic laws of electrical networks in matrix form. 15. Computer methods for the analysis of electrical circuits.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
R. C. Dorf, J. A. Svoboda	Introduction to Electric Circuits, 9th Edition, Wiley	2013	-
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
D. P. Kanoussis	Introduction to electric circuits theory, Vol. 1 (The electrical engineering series)	2017	-
C. P. Steinmetz	Theory and calculation of electric circuits, Watchmaker Publishing	2010	-

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10%
	midterm exam I	30	30%
	midterm exam II	30	30%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Second year of study	

Full name of the course	**ELECTROMAGNETICS - 1**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-022-4	compulsory	IV	6

Teacher(s)	Darko Šuka, Assistant Professor
Associate(s)	Darko Šuka, Assistant Professor

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
3	3	0	45	45	0	1,0

total teaching workload (in hours, per semester) W= 3*15 + 3*15 + 0*15 =90 hours	total student workload (in hours, per semester) T= 3*15*S_o + 3*15*S_o + 0*15*S_o = 90 hours

Total workload of the subject (teaching + student): In_{opt}= W + T = 90 + 90 = 180 hours in semester

Learning outcomes	By mastering this subject, the student will be able to: 1. evaluate the importance of fundamental experiments for the development of science in general, especially their basic role in electrical engineering, 2. recognize and understand problems that arise in practice, 3. realizes mathematical models of problems that arise in practice, 4. find a quick and economical solution using the most modern calculation and design techniques, 5. develop the skill of self-learning and upgrading knowledge, understand the importance of compliance with technical regulations and norms and legal regulations in this area of electrical engineering.
Prerequisites	Required prior knowledge of the subjects: Fundamentals of Electrical Engineering I and II and Mathematics I, II and III.
Teaching methods	The frontal method is used for lectures, and the interactive method is used for exercises. For seminar papers and homework, individual and group methods are combined
Subject content per weeks	1. Introduction to macroscopic electromagnetic fields. Definition and specificity of the electromagnetic field. 2. Electric and electrostatic field. Coulomb's law. Field and potential. Point and line electrostatic dipole. 3. Electrostatic field equations in vacuum. Conductors in an electrostatic field. Electrode systems. 4. Image theorems in the plane and spherical mirrors 5. Field of parallel differently charged threads. The field of two non-coaxial conducting sheaths 6. Image theorem in a cylindrical mirror. The electrostatic field in the material environment. Gauss's law of the vector field E, Di P. 7. Densities of bound charges and the field in the dielectric. Field equations in the material environment. Modified image theorem in a plane mirror, Boundary conditions, and the law of refraction in an electrostatic field. 8. Capacitance. Energy in the electrostatic field.

	9. Poisson's and Laplace's equation. Dirac function in electrostatics. The integral form of Poisson's equation. 10. Stationary current field. Current and current density. Continuity equation. Ohm's and Joule's law. The resistors. Point current source. Kirchhoff's laws in integral and differential form. 11. Boundary conditions and the law of refraction. Charge distribution in a stationary current field. Duality of stationary current and electrostatic field, Character theorem in the stationary current field. Conductors in a perfect dielectric. Grounding devices. 12. Stationary magnetic field. Magnetic scalar and magnetic vector-potential. Bio−Savar's law. 13. Magnetic field in the presence of matter. Boundary conditions and the law of refraction. 14. Character theorems in flat and cylindrical ferromagnetic mirrors. 15. Modified image theorem in a plane ferromagnetic mirror.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Božidar M. Krstajić	Electromagnetics with a methodical collection of tasks, Faculty of Electrical Engineering, University of East Sarajevo	2016.	9 to 284

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Antonije R. Đorđević	Electromagnetics, Academic Thought and ETF Belgrade	2008.	
B. Notaroš, V. Petrović, M. Ilić, A. Đorđević, B. Kolundžija, M. Dragović	A collection of exam questions and assignments from Electromagnetics, ETF Belgrade and Academic Thought	2002.	

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10%
	midterm exam I	30	30%
	midterm exam II	30	30%
	final exam (written/oral)	30	30%
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	Firs study cycle / Second year of study	

Full name of the course	**ELECTRONICS 2**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-023-4	compulsory	IV	5

Teacher(s)	PhD Božidar Popović, Associate Professor
Associate(s)	MSc Goran Vuković

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	45	22.5	22.5	1.5

total teaching workload (in hours, per semester) W=2*15 + 1*15 + 1*15 = 60 h	total student workload (in hours, per semester) T=2*15*S_o + 1*15*S_o + 1*15*S_o = 90 h

Total workload of the subject (teaching + student): In_{opt}= W + T = = 60 + 90 = 150 hours per semester

Learning outcomes	1. Understanding and recognizing, constructing and analyzing the operation of electronic circuits. 2. Distinguishing, recognizing and understanding the characteristics of circuits with and without feedback as well as the type and topology of feedback. 3. Distinguishing and understanding the principles of operation and ways of applying power amplifiers, constant current sources, differential amplifiers, as well as possessing the knowledge for their application. 4. Understanding, recognition and application of linear circuits with OP for the realization of complex circuits. 5. Designing and analyzing the work of linear converters and oscillators.
Prerequisites	Attended course and basic knowledge of electronics 1
Teaching methods	Lectures, auditory exercises, laboratory exercises
Subject content per weeks	1. Equivalent circuit and current gain of BJT at high frequencies. Equivalent circuit of unipolar transistors at high frequencies. Miller's theorem. Cutoff frequency of the amplifier. 2. Feedback loops, circuit structure. Circular amplification, types, topology, properties of feedback circuits. Effect of negative feedback on bandwidth. 3. Effect of negative feedback on impedance. Series-parallel series-series, parallel-series, parallel-parallel feedback. 4. Basic characteristics and division of large signal amplifiers. Amplifier in class A with transformer coupling. Non-linear distortions. 5. Symmetric amplifier in class A, B. Complementary amplifier in class B. Class AB amplifiers. Amplifier overload protection. Amplifiers in class C and D 6. Current mirrors. Widlar current source, Wilson current source. MOS current mirrors. Widlar's current source with MOS transistors 7. Differential amplifiers. 8. Differential amplifier with BJT and active load, with FET transistors.

	9. Basic properties of OP. Ideal's OP. Linear circuits with ideal operational amplifiers. 10. Real OP. Frequency characteristics of operational amplifiers. 11. Block diagram. Diode rectifiers. Rectified voltage filtering. Zener diode stabilization. Parallel and sequential stabilization. 12. Linear voltage stabilizers. Integrated voltage stabilizers. Current and temperature protection 13. Oscillators of simple periodic oscillations. Oscillation condition and frequency. Nonlinear amplitude control of the output voltage amplitude. 14. RC oscillators. Wien bridge oscillator. Phase shift oscillator. Stabilization of frequency and amplitude of oscillation. LC oscillators (Collpic, Hartley), Quartz crystal, Pierce oscillator.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
A. S. Sedra, K. C. Smith	Microelectronics Circuits, Sounders College Publishing	1991	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
G. McWhorter, A. J. Evans	Basic Electronics, Master Publishing, Inc.	2004	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	midterm exams	35	35%
	lab. exercises/practical work	10	10%
	final exam (written/oral)	50	50%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Second year of study	

Full name of the course	**OBJECT-ORIENTED PROGRAMMING**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-024-4	compulsory	IV	6,0

Teacher(s)	Danijel Mijić, PhD, Associate Professor
Associate(s)	Milica Vuković, teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	60	30	30	2

total teaching workload (in hours, per semester) W= 2*15 + 1*15 + 1*15 = 60 h	total student workload (in hours, per semester) T= 2*15*S_o + 1*15*S_o + 1*15*S_o = 120 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 60 + 120 = 180 hours per semester

Learning outcomes	1. Knowledge of the basic concepts of object-oriented programming 2. Application development skills using the object-oriented paradigm 3. Application of object-oriented concepts in a specific programming language 4. Ability to apply acquired knowledge to solve specific problems in practice
Prerequisites	None
Teaching methods	lectures, auditory exercises, laboratory exercises
Subject content per weeks	1. Introduction to object-oriented programming. Object-oriented paradigm. 2. Abstraction. Definition of objects. 3. Encapsulation. 4. Definition of class. 5. Creation of objects. 6. Constructors. 7. Destructors. Destruction of objects. 8. Access to class functions and attributes. 9. Class inheritance. Generalization. Inheritance. Methods of performance. 10. Abstract classes. Polymorphism. 11. Virtual basic classes. 12. Templates. Generic mechanism. Generating template functions. 13. Exceptions. Syntax. Exception handling. 14. Input/output. Streams. Classes for input/output streams. 15. Standard library. Container classes. General purpose classes.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Lafore, R.	Object-Oriented Programming in C++, Sams Publishing	2002	

Additional literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	lab. exercises/practical work	20	20%
	midterm exams	50	50%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO **Faculty of Electrical Engineering**	
	Study program: *Computer Science and Informatics*	
	First study cycle / Second year of study	

Full name of the course	**ENGLISH LANGUAGE 4**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-025-4	compulsory	IV	2

Teacher(s)	Darko Kovačević, PhD, associate professor
Associate(s)	

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
1	1	-	15	15	-	1

total teaching workload (in hours, per semester) W=1*15 + 1*15 + 0*15 = 30 h	total student workload (in hours, per semester) T=1*15*S_o + 1*15*S_o + 0*15*S_o = 30 h
Total workload of the subject (teaching + student): In_{opt}= W + T = 30 + 30 = 60 hours per semester	

Learning outcomes	1. familiarization with the characteristic language constructions related to the use of the English language in technical sciences, with special reference to the discourse of electrical engineering and information and communication technologies. 2. familiarization with terminology in English from various fields of technical sciences, with special reference to the discourse of electrical engineering and information and communication technologies; 3. advanced conversation related to various areas and topics related to technical sciences, with special reference to areas and topics from electrical engineering and information and communication technologies; 4. ability of understanding, translation and verbal and written description of textual units written in English and related to technical sciences, with an emphasis on electrical engineering and information and communication technologies; 5. ability to create text units related to technical sciences, with an emphasis on electrical engineering and information and communication technologies.
Prerequisites	There are no special requirements for taking courses and taking exams.
Teaching methods	method of demonstration, method of practical work, method of written work, method of reading and working on the text, method of conversation, method of oral presentation
Subject content per weeks	1. Evolution of machine learning. 2. The top myths about advanced AI 3. Future proof: cool gadgets to look forward to 4. Foldable gadgets are the future of tech 5. How much overengineering do you do? 6. What is IoT? – A Simple Explanation of the Internet of Things 7. Embedded systems - an overview 8. Introduction to embedded systems 9. Wireless power transmission 10. What is Web 3.0? A brief introduction and it's benefits. 11. What is the semantic web? 12. A complete guide to 7 renewable energy sources. 13. Energy efficiency. Guide to energy efficient devices. 14. What is the smart grid? 15. 5 ways smart grid technology is pushing renewable energy.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
D. Kovačević	Collection of texts for English Language 4 with exercises and assignments	2019	

Additional literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

Lj. Bartolić	Technical English in Electronics and Electrical Power Engineering, Školska knjiga, Zagreb	1994	

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	15	15 %
	positively evaluated seminar paper	5	5 %
	activity in lectures/exercises	10	10 %
	first test	20	20 %
	second test	20	20%
	Final examination		
	final examination (oral)	30	30 %
	TOTAL	100	100 %
Certification date			

THIRD YEAR – COMPULSORY SUBJECTS

	UNIVERSITY OF EAST SARAJEVO **Faculty of Electrical Engineering**	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	

Full name of the course	**DISCRETE MATHEMATICS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-078-5	compulsory	V	5

Teacher(s)	Vidan Govedarica, PhD, full professor
Associate(s)	Jelena Radović, MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	0	45	45	0	1.5

total teaching workload (in hours, per semester) W=2*15 + 2*15 + 0*15 = 60 h	total student workload (in hours, per semester) T=2*15*S_o + 2*15*S_o + 0*15*S_o = 90 h
Total workload of the subject (teaching + student): In_{opt}= W + T = 60 + 90 = 150 hours per semester	

Learning outcomes	By mastering this subject, the student will be able to: 1. master the basic concepts of number theory and its applications 2. master the basic concepts of combinatorics and its applications 3. master the basic concepts of graph theory and its applications in computing 4. use acquired knowledge in professional subjects.
Prerequisites	There are no special requirements for taking courses and taking exams.
Teaching methods	The teaching process is realized mainly through the frontal form of work - lectures and interactive form of work - auditory exercises.
Subject content per weeks	1. Divisibility of whole numbers. Mutually prime numbers. Euclid's algorithm. 2. Prime numbers. Basic attitude of arithmetic. Multiplicative functions. 3. Relation of congruence. Euler's function and Euler's theorem. Wilson's theorem. 4. Linear Diophantine equations. System of linear congruences. Chinese remainder theorem. 5. Pythagorean triples. Final fields. 6. Permutations, variations and combinations. Compositions and partitions. 7. The inclusion and exclusion formula. Stirling numbers of the first and second kind. 8. Fibonacci numbers. Generative functions. 9. Linear recurrent relations with constant coefficients. 10. Catalan numbers. Good streaks. Stack. 11. Concept of graph. Degrees of nodes. Adjacency matrices. 12. Paths in the graph. Connection of graphs. Euler and Hamilton graphs. 13. Isomorphism of graphs. The complement of a graph. Tree. 14. Planar graphs. Graph coloring. 15. Determining the shortest path in a graph. Dijkstra's algorithm. History of graph theory.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
V. K. Balakrishnan	Introductory Discrete Mathematics, Dover Publications	2010	

Additional literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
S. S. Epp	Discrete Mathematics with Applications, 5th Edition, Cengage Learning	2019	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	attendance at lectures/exercises	10	10 %
	midterm exam I	30	30 %
	midterm exam II	30	30 %

	Final examination		
	final examination (oral)	30	30 %
	TOTAL	100	100 %
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	

Full name of the course	**FUNDAMENTALS OF TELECOMMUNICATIONS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-041-5	compulsory	V	5,0

Teacher(s)	Mirjana Maksimović, PhD, Associate Professor
Associate(s)	Milica Vuković, BSc, teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	45	22.5	22.5	1.5

total teaching workload (in hours, per semester) W=2*15 + 1*15 + 1*15 =60 hours	total student workload (in hours, per semester) T= 2*15*S_o + 1*15*S_o + 1*15*S_o = 90 hours

Total workload of the subject (teaching + student): In_{opt}= W + T = 60+90 = 150 hours per semester

Learning outcomes	The course aims to teach students: 1. basic procedures for analyzing analog and digital signals, 2. linear and non-linear transmission systems, 3. the principles of transmission of analog and digital signals in the basic and transposed ranges, and 4. working in the laboratory and becoming familiar with practical communication systems.
Prerequisites	There are no prerequisites for enrolling the course. It is necessary to have prior knowledge of the following subjects: Fundamentals of Electrical Engineering, Analysis of Signals and Systems, Mathematics I, II, and III.
Teaching methods	Teaching is conducted in the form of lectures, auditory and laboratory exercises. The Moodle platform is used to create the content of teaching units, store teaching materials and results of pre-exam obligations and final exams, as well as for communication with students.
Subject content per weeks	1. Introduction. Model of the telecommunication system. 2. Classification of signals. Analysis of deterministic signals: Fourier series (periodic signals) and Fourier transform (aperiodic signals). 3. Signal characteristics of real messages (telegraphy, data transmission, speech, music, TV image). 4. Signal transmission through linear and non-linear systems (linear and non-linear distortions). 5. Modulation and demodulation of analog signals: amplitude (KAM, AM-DSB, AM-SSB, AM-NSB, QAM). 6. Modulation and demodulation of analog signals: phase modulation and frequency modulation. 7. Principles of frequency multiplexing. 8. Sampling theorem. Quantization. 9. Impulse modulation: PAM, PWM, PPM, PCM. 10. Multiplex with time distribution of channels. 11. Model of the digital transmission system and basic characteristics of digital signals. 12. Model of the transmission system in the baseband frequency range.

	13. Signal transmission in the baseband frequency range. Influence of noise and intersymbol interference. 14. Nyquist's criteria. 15. Modulation and demodulation of digital signals: ASK, PSK, FSK.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
M. Maksimović	Lecture presentations available on the Moodle platform		
R. L. Freeman	Fundamentals of Telecommunications, Wiley	1999.	
R. G. Gallager	Principles of Digital Communications, MIT, Cambridge University Press	2012.	
V. Milošević, M. Maksimović	Fundamentals of Telecommunications – Practicum, East Sarajevo	2013.	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	midterm exam I	20	20%
	midterm exam II	20	20%
	Laboratory exercises	10	10%
	final exam (written/oral)	45	45%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	
Full name of the course	**DIGITAL ELECTRONICS**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-03-1-033-5	compulsory	V	6

Teacher(s)	Prof. dr Milomir Šoja, full professor
Associate(s)	Zorana Mandić, teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	1	$2*15*S_o$	$2*15*S_o$	$1*15*S_o$	1.4

total teaching workload (in hours, per semester) $W=2*15+2*15+1*15=75$	total student workload (in hours, per semester) $T=2*15*S_o+2*15*S_o+1*15*S_o=105$

Total workload of the subject (teaching + student): $In_{opt}= W + T = 180$ hours per semester

Learning outcomes	Upon successful completion of the course the students will be able to: 1. Understand importance of the semiconductor switches used for design of digital circuits, 2. Design logic function using standard logic gates, 3.Choose right logic family for design of digital circuits, while taking in consideration real characteristics, 4. Understand operation of the combinational logic circuits and design complex combinational circuits, 5. Understand operation of the sequential logic circuits and design complex sequential circuits, 6. Understand operation and correct uses of memory circuits, 7. Understand operation and correct uses of A/D and D/A convertors, 8. Understand structure and principles of programmable digital circuits.
Prerequisites	For enrollment in Digital electronics course, students should have basic electronics and impulse electronic knowledge (from courses: Electronics I and II and Impulse electronics). For successful complementation, students must have average of a 50% or more in all pre-exams and in the final exam.
Teaching methods	Lectures, auditory practical lectures, labs.
Subject content per weeks	***Module: Introduction*** **1.1** Students responsibility and grading system. Analog/digital signals. ***Module: Semiconductor switches*** **1.2** Characteristics of ideal and real switches and theirs models. ***Module: Logic gates*** **2.** Logic gates and functions. **3.** Logic gates design. Logic families – CMOS. Real logic circuits. ***Module: Combinational circuits*** **4.1** Definition and design of the combinational circuits. Decoders. **4.2.** Coders. **5.1.** Multiplexers. **5.2** Demultiplexers. **6.** Arithmetic circuits (adder, binary comparators, multipliers).

	Module: Astable and monostable multivibrators **7.1.** Astable multivibrators – pulse generators. **7.2.** Monostable multivibrators. ***Module: Sequential circuits*** **8.1** Definition, basic types and design of the sequential circuits. **8.2** Latch and flip-flops. **9.** Latch and flip-flops. **10.** Registers. Buses. **11.** Counters. Types and design procedures. ***Module: Semiconductors memorys*** **12.** ROM, PROM, EPROM, E2PROM. **13.** RAM, SRAM, DRAM. ***Module: A/D D/A converters*** **14.** A/D, D/A converters. ***Module: Programmable logic circuits*** **15.** PAL, PLA, CPLD, FPGA.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Šoja, M.	Lecture notes (digital form), Faculty of Electrical Engineering	2022.	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Anil K. Maini	Digital Electronics: Principles, Devices and Applications, John Wiley & Sons	2007.	
Tony R. Kuphaldt	Lessons In Electric Circuits, Volume IV - Digital, Fourth Edition, Open Book Project collection, http://www.ibiblio.org/obp	2002.	

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5 %
	homework	5	5 %
	lab. exercises/practical work	10	10 %
	midterm exams	25+25	25 %+25 %
	final exam (written/oral)	30	30 %
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	
Full name of the course	**OPERATING SYSTEMS**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-111-5	compulsory	V	5,0

Teacher(s)	Snježana Milinković, PhD, Assistant Professor
Associate(s)	Budimir Kovačević, MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	45	22.5	22.5	1.5

total teaching workload (in hours, per semester) W=2*15 + 1*15 + 1*15 =60 hours	total student workload (in hours, per semester) T= 2*15*S_o + 1*15*S_o + 1*15*S_o = 90 hours

Total workload of the subject (teaching + student): In_{opt}= W + T = 60+90 = 150 hours per semester

Learning outcomes	By mastering this subject, the student will: 1. acquire basic knowledge about the concepts and principles of modern operating systems, 2. acquire theoretical and practical knowledge about internal design and implementation of modern operating systems, 3. understand the problems that are encountered and the solutions that are implemented during design of modern operating systems.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge of the courses: Fundamentals of computer technique, Introduction to programming, Programming languages.
Teaching methods	Lectures, auditory and laboratory exercises.
Subject content per weeks	1. Introduction. Definition and structure of system software. Connection of system software and hardware of the computer. The place of system software in the process of manufacturing and using computers. 2. Operating systems. Operating system as a component of system software. Functions, components, architecture, generations, classification, operating modes. 3. Examples of operating systems. Commands and system calls. Examples: MS Windows, UNIX... 4. Processes: definition, process states, management structures, operations with processes, competitive processes. 5. Threads: definition, connection of threads and processes, implementation of threads, examples of application of threads. 6. Synchronization and communication between processes. 7. Deadlock. 8. Schledulling - algorithms and strategies. Examples: MS Windows, Unix... 9. Memory management system. Functions of the memory management subsystem. 10. Memory allocation. Paging and segmentation. 11. Memory protection and sharing. Memory management strategies. Examples.

	12. Virtual memory. 13. I/O - functions, principles and techniques. Structure of the I/O system. 14. File system – concepts and functions 15. Implementation of the file management system. File system security.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
A. Silberschatz, P. Baer Galvin, G. Gagne	Operating System Concepts, John Wiley & Sons, Inc.	2013	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
I. D. Craig	Formal Models of Operating System Kernels, Springer	2007	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	Laboratory exercises	20	20%
	midterm exam I (optional)	40	40%
	midterm exam II (optional)	40	40%
	final exam (written/oral)	80	80%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle | Third year of study	

Full name of the course	**COMPUTER ARCHITECTURE AND ORGANIZATION**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-075-5	compulsory	V	6,0

Teacher(s)	PhD Nikola Davidović, Assistant professor
Associate(s)	PhD Nikola Davidović, Assistant professor

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**L**
3	1	1	63	21	21	1,4

total teaching workload (in hours, per semester) 75 h	total student workload (in hours, per semester) 105 h

Total workload of the subject (teaching + student): 180 hours in semester

Learning outcomes	By mastering this subject, the student will be able to: 1. To describe and explain the basic terms, concepts and technologies of the organization of computer systems. 2. Designing the architecture of a set of instructions and elements of computer implementation at the level of its functional blocks. 3. To recognize the convenience of applying certain computer architectures. 4. To be able to participate in the specification of requirements for computer architecture.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge of the subject: fundamentals of computer engineering, programming, logical design and digital electronics.
Teaching methods	lectures, auditory exercises, laboratory exercises
Subject content per weeks	1. Organization and operation of a simple computer. Computer performance. 2. Types of processor architectures. Basic functional blocks of the processor. Addressing modes. A processor's instruction set. 3. Computer interrupt system. Examples of instruction set architectures. 4. Processor implementation. Single-cycle processor. Multi-clock processor. 5. Processor control unit with direct and microprogram management. 6. Concept of flow execution of instructions. Structural hazards. Data hazards. 7. Avoidance of data hazards. Hazards of management. More complex flow systems. 8. Computer arithmetic with whole numbers. Addition, multiplication and division operations. 9. Representation of floating point numbers. Arithmetic operations with floating point. 10. Memory implementations in different technologies 11. Associative memories. Hierarchical organization of memory. Cache memory. 12. Main memory. Virtual memory. 13. Processor interface with other computer elements. Operation management of typical I-O devices. 14. Organization of I-O activities. 15. System and local buses. Arbitration on the buses. Bus protocols. Examples of standard buses.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Milenković N.	Computer architecture and organization, EF Niš	2004.	
Stallings, W.	Computer organization and architecture	2013.	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Patterson, D., Hennessy, J.	COMPUTER ORGANIZATION AND DESIGN: The Hardware/Software Interface,	2009.	
Andrew Tanenbaum	Structured Computer Organization, Pearson	2013.	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	tests (optional)	10	10%
	homework (optional)	10	10%
	laboratory exercises	10	10%
	midterm exam I (optional)	20	20%
	midterm exam II (optional)	20	20%
	Final exam		
	final written exam (optional)	40	40%
	final oral exam	40	40%
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	
Full name of the course	**PRACTICAL TEACHING**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-157-5	compulsory	V	3,0

Teacher(s)	Vladimir Vujović, PhD, Associate Professor
Associate(s)	Milica Vuković, BSc, teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
1	0	2	15	0	30	1

total teaching workload (in hours, per semester) W=1*15 + 0*15 + 2*15 =45 hours	total student workload (in hours, per semester) T= 1*15*S_o + 0*15*S_o + 2*15*S_o = 45 hours

Total workload of the subject (teaching + student): In_{opt}= W + T = 45+45 = 90 hours per semester

Learning outcomes	By mastering this subject, students will: 1. be able to demonstrate understanding, critical analysis and application of valid theories, models and techniques in the field of software engineering. 2. be able to choose and actively apply the optimal methodology and tools for concrete software project, as well as to justify their choice. 3. be able to successfully use modern techniques and tools in software development (integrated development environments, editors, compilers, debuggers, etc.). 4. be able to successfully collaborate on software development within a multi-member team, use tools for collaboration, version control systems, and change request tracking systems. 5. be able to understand and use basic methodological approaches in software development, to write documentation and use tools to write documentation for the software they develop. 5. be able to recognize and define requirements, as well as design Use-Case diagrams.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge of the subject: Object oriented programming.
Teaching methods	Lectures, laboratory exercises.
Subject content per weeks	1. Introduction to software engineering. Basic terms and motivation for the creation of software engineering. 2. The relationship between the software process and the software product. The relationship between programming and software engineering. Software Engineering Body of Knowledge (SWEBOK). 3. Approaches to software development. The life cycle of a software product and the concept of a life model of software cycle. 4. Traditional software life cycle models: waterfall-based models (linear, modified, V-model). 5. Traditional software life cycle models: spiral model, models based on prototypes, rapid development models.

	6. Agile and adaptive software life cycle models: SCRUM, extreme programming, Feature Driven Development – FDD. 7. Agile and adaptive software life cycle models: Dynamic Systems Development Method - DSDM, Kristal, Adaptive Software Development - ASD. 8. Modern tools to support the software development process. Integrated development environments (overview, advantages, disadvantages, effective use). 9. Testing and Debugging. Application of debugging tools as part of integrated development environments. 10. Extensions of working environments: support for teamwork, planning, monitoring of activities (Redmine). Collaborative tools. 11. Extensions of working environments: version control systems (Version Control System - VCS): Subversion, Git. 12. Writing software product documentation. Documenting the source code. Technical documentation and user manual. Tools for writing and generating documentation (JavaDOC, Doxygen). 13. Modern tools to support the software modeling process (PowerDesigner, Enterprise Architect, Eclipse Modeling Project, ArgoUML, GenMyModel). 14. Fundamentals of requirements engineering, process, statement, analysis, specification, verification and request validation. Creation of a formal document - specification of requirements. Modeling requests. 15. Functional software modeling. The use of UML Use-Case diagrams in formulating the interaction of the user and the software product. Screenwriting: prerequisites, steps, exceptions, extensions, post-conditions).

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Pfleger, S. L., Atlee, J. M.	Software Engineering: Theory and Practice (fourth edition), Pearson	2009	
Zukowski, J.	The Definitive Guide to Java Swing (third edition), Apress	2005	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Stephens, R.	Beginning Software Engineering, John Wiley & Sons	2015	

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10%
	development of the vision, requirement model and functional model of chosen application	20	20%
	Final exam		
	theory	30	30%
	written exam	40	40%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	

Full name of the course	**ALGORITHMS AND DATA STRUCTURES**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-073-6	compulsory	VI	5,0

Teacher(s)	Vladimir Vujović, PhD, Associate Professor
Associate(s)	Miljan Sikimić, MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	0	45	45	0	1.5

total teaching workload (in hours, per semester) W=2*15 + 2*15 + 0*15 =60 hours	total student workload (in hours, per semester) T= 2*15*S_o + 2*15*S_o + 0*15*S_o = 90 hours

Total workload of the subject (teaching + student): In_{opt}= W + T = 60+90 = 150 hours per semester

Learning outcomes	By mastering this subject, the student will: 1. understand the basic concepts of algorithms and data structures (linear and non-linear structures, search and sorting algorithms), as well as analysis of algorithm efficiency. 2. be able to implement linear and non-linear structures, as well as algorithms needed to work with them in typical applications. 3. to be trained in the practical implementation of search and sorting algorithms in programming languages. 4. be able to solve practical problems relying on studied algorithms and structures.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge of the subjects: Fundamentals of computer techniques, Introduction to programming and Discrete mathematics.
Teaching methods	Lectures, auditory exercises, seminar paper
Subject content per weeks	1. Introduction. Concepts of algorithms and data structures. 2. Linear data structures. Arrays (operations, arrangement by types and columns, ...). 3. Chained lists (operations with chained lists, circular lists and lists with a header, applications). 4. Stacks and queues (operations, sequential and chained representation, applications). 5. Non-linear data structures. Trees (terminology, binary trees, traversal, applications). 6. Graphs (presentation, traversal of the graph by width and depth, algorithms - Prim, Kruskal). 7. Graphs (algor. -Warshall, Floyd, Dijkstra, Ford-Fulkerson, matching, topological ordering and critical path). 8. Search. Basic search methods (sequential and binary) and theirs improvements. 9. Binary search tree (examination, insertion and deletion). 10. Balancing - AVL and other nearly optimal trees, applications. 11. General search trees (M-ary search trees, B, B*trees). 12. General search trees (B+ trees). Digital search trees.

	13. Hashing (f's are dependent and independent of key distribution, open address and chain, external h.). 14. Internal sort: insert method (direct, Shellsort).Internal sort: method selection (direct, using the selection tree, Heapsort). 15. Internal sorting: replacement method. Sorting methods of linear complexity (Radix, counting sort, address sort), sort performance.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Cormen, T. H., Leiserson, C. E., Rivest, R. L., Stein, C.	Introduction to Algorithms, Third Edition, MIT Press	2009	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Lafore, R.	Data Structures and Algorithms in Java (2nd Edition), SAMS	2003	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10%
	seminar paper/project (optional)	10	10%
	midterm exam I (optional)	40	40%
	midterm exam II (optional)	50	50%
	Final exam		
	final exam (written/oral)	90	90%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	

Full name of the course	**DATABASES**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-076-6	compulsory	VI	7,0

Teacher(s)	PhD Srđan Nogo, Associate professor
Associate(s)	Marko Malović, BSc, teaching assistant

Fund of classes/teaching load (weekly)			**Individual student load (in semester hours)**			**Cofficient of student load S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
3	1	2	60	20	40	1,33

total teaching workload (in hours, per semester) 90	total student workload (in hours, per semester) 120

Total workload of the subject (teaching + student): In_{opt}= W + T = 90+120 = 210 hours per semester

Learning Outcomes	By completing this course, the student will be able to: 1. Master the basic terms and principles of the Database Management System- DBMS and the basic concepts of database design 2. Design and implements specific databases and the use of software tools for database management 3. Has knowledge of complex algorithms and techniques used in the practical implementation of todays DBMS 4. Databases Administration
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge in the subjects: Computer Architecture and Organization, Object Oriented Programming and Operating Systems.
Teaching methods	Lectures (L), auditory exercises (AE) and laboratory exercises (LE)
Subject content per weeks	1. Introduction to database management systems. Database concept. Scheme. Instances. 2. Data models. Languages for working with databases. System overview. 3. The entity-relationship model. Conceptual modeling. Entity-relationship diagram. Types of connections. 4. Relational query languages. Relational algebra. Relational calculus. Query optimization. Structured Query Language - SQL 5. Relational Database design. Project requirements. Expression of Limitations. 6. Functional Dependencies. Multi-valued dependencies. Merge Dependencies 7. Normal Forms. Alternative approaches to design 8. Object Oriented Databases 9. Modularity. Hierarchy. Types. Competitiveness. Duration. Objects. Classes. Inheritance. 10. Interfaces. Object-oriented extension of the Relational Model. 11. Installation and access to the database. 12. The possibility of diagnosing and eliminating errors in the operation of databases. Database backup and recovery. 13. Database performance management 14. Security of databases. 15. Ways to solve problems caused by concurrent access to the database in case of system failure. Database storage management.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Nogo. S.	Basics of database systems, Faculty of Electrical Engineering, University of East Sarajevo	2018	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Alapati, S., Kim, C.	Oracle Database 11g New Features for DBAs and Developers	2007	
Bojovic, M.	Database Management	2003	

	Type of student work-evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-exam obligations		
	Attendance at lectures/exercises	5	5%
	Laboratory exercises	15	15%
	1. Colloquium	20	20%
	2. Colloquium	20	20%
	Final exam		
	Final exam (oral/ written)	40	40%
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	

Full name of the course	**DATA TRANSMISSION**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-02-1-118-6	compulsory	VI	6,0

Teacher(s)	Mirjana Maksimović, PhD, Associate Professor
Associate(s)	Nataša Popović, PhD, Assistant Professor

Number of lessons/teaching workload (weekly)			**Individual student workload (hour per semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	1	42	42	21	1,4

Total teaching workload (in hours, per semester) 75	Total student workload (in hours, per semester) 105

Total workload of the subject (teaching + student): W + T = U_{opt} hours in semester
180

Learning outcomes	By mastering this subject, the student will: 1. become familiar with the basic concepts of electronic communication systems, 2. acquire fundamental knowledge about computer networks and their operation, 3. acquire theoretical and practical knowledge of the data transmission concepts in communication networks, 4. get acquainted with data acquisition systems, intelligent sensors and the concept of the Internet of Things.
Prerequisites	There are no prerequisites for enrolling the course. It is necessary to have prior knowledge of the following subjects: Fundamentals of Telecommunications, Architecture and organization of computers
Teaching methods	Teaching is conducted in the form of lectures, auditory and laboratory exercises. Learning, tests and consultations.
Subject content per weeks	1. Introduction. History of communication systems. Telegraph and telephone. Radio and television. Computer networks and the Internet. 2. Fundamentals of communications and data transfer. A model of the communication system. Network hardware. Network software. OSI and the TCP/IP model. Comparison of models. Standardization. 3. Physical layer. Theoretical foundations of data transmission. Digital and analog transmission. Digital modulations. Multiplexing. 4. Physical layer. Data transmission methods: asynchronous and synchronous transmission. Protocols: RS-232, RS-485, I^2C, SPI. 5. Physical layer. Transmission media and characteristics: wired and wireless. Repeater and hub. Collision and collision domains. 6. Physical layer. Topologies. Physical layer protocols. USB, Wi-Fi, Bluetooth. 7. Data link layer. Framing. Error control. Error correction. Hamming code. 8. Data link layer. Basic data link layer protocols. Examples of data link layer protocols: HDLC, PPP. 9. Data link layer. Media Access Control. Ethernet. Token Ring, FDDI, Frame Relay, ATM. Bridge and switch. 10. Network layer. Datagrams, virtual circuits. Addressing. Comparison of IPv6 and IPv4. Network layer protocols. Router. Routing. 11. Transport layer. TCP, UDP. Session level. Presentation level. Application level. DNS. E-mail. Web. 12. Telephone networks and systems. ISDN, xDSL. FttH. Mobile communication systems: 1G, 2G, 3G, 4G, 5G. 13. Internet telephony. Cable TV. Cable Internet.

	14. Satellite systems. LEO, MEO, GEO. Allocation of capacity. Wireless sensor networks. 15. The Internet of Things. Data acquisition systems.

Compulsory literature			
Author(s)	**Publication title, Publisher**	**Year**	**Pages (from-to)**
M. Maksimović	Lecture presentations		
A. S. Tanenbaum, D. J. Wetherall	Computer Networks, Prentice Hall	2011.	

Additional literature			
Author(s)	**Publication title, Publisher**	**Year**	**Pages (from-to)**
R. G. Gallager	Fundamentals of Telecommunications, Wiley	1999.	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	Attendance at lectures/exercises	5	5 %
	1st test	22.5	22.5 %
	2nd test	22.5	22.5 %
	Final exam		
	Final exam (written/oral)	50	50 %
	TOTAL	100	100 %
Web page			
Certification date			

FOURTH YEAR – COMPULSORY SUBJECTS

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering ***Study program:*** *Computer Science and Informatics* First study cycle | Fourth year of study	

Full name of the course	**COMPUTER NETWORKS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-130-7	compulsory	VII	5,0

Teacher(s)	Danijel Mijić, PhD, Associate Professor
Associate(s)	Budimir Kovačević, MSc, Senior Teaching Assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	45	22,5	22,5	1,5

total teaching workload (in hours, per semester) W=60	total student workload (in hours, per semester) T=90

Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester

Learning outcomes	1. Knowledge of models, protocols, services, and applications in computer networks 2. Understanding the functions, technologies, and architecture of modern computer networks 3. Acquiring the skills needed to establish and use simple local computer networks and selected internet services 4. Ability to configure various network devices
Prerequisites	None
Teaching methods	lectures, laboratory exercises, seminars, practical work
Subject content per weeks	1. History of computer networks. Use of computer networks. 2. ISO/OSI reference model. Protocols and services. TCP/IP reference model. 3. Network hardware and software. 4. Data link layer. Error control and flow control. Error detection techniques. 5. Sliding window protocols. Protocol examples: HDLC, PPP. 6. Local networks. CSMA/CD. IEEE standard 802 for LAN. 7. Addressing. Network connection: repeaters, bridges, switches, hubs. 8. Network layer. Connection and connectionless service. 9. Routing algorithms. Principle of optimality. Spanning tree. 10. Dijkstra's algorithm, flooding, Distance vector, Link state algorithms. 11. Hierarchical routing. Congestion control. Network layer in the Internet. IP protocol. NAT. ICMP, ARP, DHCP. RIP protocol. 12. Transport layer. Transport services. Quality of Service (QoS). 13. Internet transport protocols: TCP and UDP. Sockets. 14. Application layer. Network applications. DNS, E-mail, TELNET, FTP, WWW, HTTP. 15. Network security and cryptography. Secret key cryptography. Public key cryptography. DES. RSA. SSL protocol.
Compulsory literature	

Author(s)	Publication title, publisher	Year	Pages (from-to)
Tanenbaum, A.	Computer Networks, Pearson	2010	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Kurose, J. F, Ross, K. W.	Computer networking: A top-down approach featuring the Internet, Pearson education, Addison Wesley	2003	

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises		
	homework		
	lab. exercises/practical work	20	20%
	midterm exams	40	40%
	final exam (written/oral)	40	40%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering ***Study program:*** *Computer Science and Informatics* First study cycle | Fourth year of study	

Full name of the course	**PROGRAM TRANSLATORS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-125-7	compulsory	VII	5,0

Teacher(s)	PhD Marijana Ćosović, assistant professor
Associate(s)	Zorana Štaka, MSc, senior teaching assistant Milica Vuković, BSc, teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	45	22,5	22,5	1,5

total teaching workload (in hours, per semester) W=60	total student workload (in hours, per semester) T=90

Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester

Learning outcomes	1. Knowledge of the basic principles and concepts of a program translator. 2. Understanding the algorithms used in program translators. 3. Independent definition of simple and complex programming languages. 4. Generating a program translator.
Prerequisites	There are no requirements for registering and listening to the course.
Teaching methods	Lectures, auditory exercises, laboratory exercises, practical work
Subject content per weeks	1. Development of programming languages and translators. Types of program translators. 2. Assemblers and macroprocessors. Macroprocessors' languages. Macroprocessors' functions. 3. Formal languages and grammar. 4. Automata as language recognition devices. Turing machine and zero-type languages. Linearly bounded automata. Pushdown automata. Finite automata. 5. Lexical analyzer. LEX- a lexical analyser generator. 6. Syntax analysis. Basic terms. Basic approaches to syntax analysis. 7. Syntax analysis from top to bottom (Top-Down). LL- analysers with and without rules. 8. Syntax analysis from the bottom up (Bottom-Up). LR analyzers 9. An operator precedence grammar and analysis based on them. 10. YACC – generator of syntax analyzers 11. Semantic superstructure of syntax analyzers. The superstructure of Top-down and Bottom-Up analyzers. 12. Intermediate codes. Static and dynamic data structures for syntax tree memory. Three-address intermediate code. Polish inverse notation as an intermediate code. Generating and interpreting code based on intermediate code. 13.Code optimization. Basic optimization. Additional, machine-independent code optimization.

	14. Allocation and structure of memory allocated to the program. Syllables activation and subprogram implementation. Static and dynamic memory allocation. Allocation using the stack. 15. Realization of the compiler. Compilers as a tool for generating new compilers - the bootstrapping technique. Examples of commercial compiler solutions.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
A.B. Aho, M.S. Lam, R. Sethi, J.D. Ullman	Compilers, Principles, Techniques, and Tools	2006	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
D. Thain	Introduction to Compilers and Language Design	2020	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10 %
	homework	15	15 %
	lab. exercises/practical work	15	15 %
	midterm exams	30	30 %
	final exam (written/oral)	30	30 %
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Fourth year of study	
Full name of the course	**MICROPROCESSOR SYSTEMS**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-043-7	compulsory	VII	5.0

Teacher(s)	PhD Slobodan Lubura, full professor
Associate(s)	Nikola Kukrić, MSc, teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	$2*15*S_o$	$1*15*S_o$	$1*15*S_o$	1.5

total teaching workload (in hours, per semester) W= L*15 + AE *15 + LE *15 =60	total student workload (in hours, per semester) T= $L*15*S_o$ + $AE*15*S_o$ + $LE*15*S_o$ =90

Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester

Learning outcomes	Upon completion of the course the students be will be able: 1. Demonstrate knowledge and understanding of the fundamental principles embedded systems design, explain the process and apply it. 2. Demonstrate knowledge and understanding related to the selection of a microcontroller (microprocessor) as a hardware component for a given application 3. Demonstrate knowledge and understanding microprocessor's peripherals and their use in certain applications 4. Have knowledge of microcontrollers programming in C using integrated development environments (IDE) and using debugging techniques 5. Demonstrate knowledge and understanding of peripheral devices used in embedded computer systems and how to connect them to microcontrollers. 7. Design and implement a complete embedded system as a project.
Prerequisites	Digital electronics, Introduction to programming in C
Teaching methods	• Interactive lectures and communication with students • Auditory exercises • Lab exercises • Homework
Subject content per weeks	1. Basic principles of design embedded systems 2. Data path of a simple microcontroller, organization of program and data memory 3. The development environment (IDE) for programming microcontrollers in C 4. CPU and ALU unit 5. Instruction set and addressing modes 6. I/O port specification 7. Interrupt system and technique for handling interrupts 8. Timer/counter modules 9. UART synchronous and asynchronous serial communication module 10. MSSP module (SPI and I2C) for serial synchronous communication 11. CCP and PWM modules

	12. A/D conversion and analogue comparator module 13. Microcontrollers oscillator module and reset modes 14. WDT timer; EEPROM module 15. Loops timing and computed GOTO technique

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Milan Verle	PIC microcontrollers Programming in C, MikroElektronika Ltd	2009	all
Martin P. Bates	Programming 8-bit PIC microcontrollers in C, Newnespress	2002	all

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Martin P. Bates	Interfacing PIC Microcontrollers Embedded Design by Interactive Simulation, Elsevier	2006	all

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10%
	Class Deliverables	40	40%
	midterm exams	-	-
	final exam (written/oral)	50	50%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Fourth year of study	

Full name of the course	**INTERNET TECHNOLOGIES AND PROGRAMMING**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-095-7	compulsory	VII	7,0

Teacher(s)	Danijel Mijić, PhD, Associate Professor
Associate(s)	Miljan Sikimić, MSc, Senior Teaching Assistant Zorana Štaka, MSc, Senior Teaching Assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	1	54	54	27	1,8

total teaching workload (in hours, per semester) W=75	total student workload (in hours, per semester) T=135

Total workload of the subject (teaching + student): In_{opt}= W + T = 210 hours per semester

Learning outcomes	1. Knowledge of internet technologies and services 2. Knowledge of the main web technologies for client-side and server-side programming 3. Skills in developing client and server components of web applications 4. Ability to work independently and as a team on web application development
Prerequisites	None
Teaching methods	lectures, laboratory exercises, seminars, practical work
Subject content per weeks	1. Development of the Internet. Protocols and addresses. Standards. Basic internet services. 2. Web. An overview of the development of web technologies. Basic web technologies. 3. HTML. HTML versions. Tags. Document structure. Arrangement of elements. 4. CSS. Selectors. Attributes. Pseudo classes. 5. XML technologies (DTD, XML Schema, DOM, SAX. XSLT). 6. Client programming. Elements of the JavaScript language. 7. Ajax. JSON. JavaScript libraries. 8. Server programming. Technologies for server programming. 9. Elements of PHP language and technology. 10. Application state management. Transfer of parameters. Sessions. 11. Multi-tier web applications. Architecture of multi-tiered web applications. 12. Presentation layer. Business logic layer. Data layer. 13. Elements of ASP.NET and Java technology. 14. Service-oriented architecture. Web services. 15. Tools for rapid development of web applications.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Welling, L, Tompson, L.	PHP and MySQL Development, Developers Library	2010	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises		
	homework		
	lab. exercises/practical work	20	20%
	midterm exams	50	50%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle | Fourth year of study	
Full name of the course	**INFORMATION SYSTEMS DESIGN**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-126-8	compulsory	VIII	7,0

Teacher(s)	Vladimir Vujović, PhD, Associate Professor
Associate(s)	Milica Vuković, BSc, teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
3	2	1	60	40	20	1,33
total teaching workload (in hours, per semester) W=90			total student workload (in hours, per semester) T=120			
Total workload of the subject (teaching + student): In_{opt}= W + T = 210 hours per semester						

Learning outcomes	By mastering this subject, students will: 1. be able to understand the basic concepts of information systems, their role in the environment and architecture. 2. master the basics of professional software development and information systems design. 3. be trained for the independent implementation of complex software solutions that include data storage design (conceptual, logical, physical design) and design graphical user interface in accordance with specified standards. 4. be able to create a modern reporting subsystem of the information system, as well as to include the basic concepts of protection (authorization and authentication of access) of information system. 5. master the elements of teamwork (collaboration and collaborative tools), as well as principles of software project management.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge of the subjects: Object oriented programming, Software specification and modeling, Software design, Databases, Internet technologies and programming.
Teaching methods	lectures, auditory exercises, laboratory exercises, team project
Subject content per weeks	1. Basic concepts of information systems. Elements of architecture and types of information systems. 2. The role of information systems within business systems. 3. Phases in the evolution of information systems. 4. Challenges of modern technologies and concepts in the domain of designing information systems. 5. Architecture and design of information systems. 6. Planning, analysis and design of information systems. 7. Designing and projecting the user interface. Interaction with users. 8. Data warehouse design. Conceptual and logical modeling of information system. 9. Physical modeling. Index structures. Database schema generation. 10. Business logic and its residency. Business logic modeling.

	11. Modeling and query specification. Triggers and Stored Procedures. 12. Reporting subsystem of information systems. 13. Protection of business information systems. Authentication and access authorization. RBAC access control. 14. Recovery, maintenance, introduction and decommissioning of business information system. 15. Service-oriented information systems.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Pfleger, S. L., Atlee, J. M.	Software Engineering: Theory and Practice, Pearson	2009	
Shneiderman, B., Plaisant, C., Cohen, M., Jacobs, S.	Designing the User Interface: Strategies for Effective Human-Computer Interaction (fifth edition), Pearson	2009	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Stair, R. M., Reynolds, G. W.	Fundamentals of Information Systems (six edition), Course Technology	2012	
Langer, A. M.	Analysis and Design of Information Systems (third edition), Springer	2008	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10%
	team project	40	40%
	Final exam		
	final exam (written/oral)	50	50%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Fourth year of study	

Full name of the course	**PARALLEL COMPUTER SYSTEMS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-1-115-8	compulsory	VIII	6,0

Teacher(s)	PhD Nikola Davidović, Assistant professor
Associate(s)	Milica Vuković, BSc, teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	2	42	21	42	1,4
total teaching workload (in hours, per semester) W=75			total student workload (in hours, per semester) T=105			
Total workload of the subject (teaching + student): In_{opt}= W + T = 180 hours per semester						

Learning outcomes	1. Understanding the basics of parallel processing. 2. Knowledge and understanding of architecture based on parallelism. 3. Knowledge of the design and performance of parallel algorithms. 4. Creating algorithms based on parallel programming in some environment.
Prerequisites	Prior knowledge of computer architecture and organization, algorithms and data structures, and operating systems is required.
Teaching methods	lectures, auditory exercises, laboratory exercises
Subject content per weeks	1. Introduction. History. Taxonomy. 2. Performance of computer systems. 3. Amdahl's law. Efficient parallel algorithms. The principle of unlimited parallelism. 4. Data dependencies. Real addictions. Anti-addiction. Output dependencies. 5. Eliminating antidependencies and output dependencies. 6. Fine-grained parallelism and systolic fields. Systolic fields and systolic algorithms. Topologies. Performance. 7. Synthesis of one- and two-dimensional fields based on the systolic algorithm. 8. Synthesis of 2D and 1D fields for the matrix product. Optimization of spatial and temporal parameters 9. SIMD processor fields. Processor arrays with distributed memory. Processor arrays with common (shared) memory.. 10. Interconnection networks (IN). Static IN. Dynamic IN. Single-stage IN. Multilevel IN 11. Examples of SIMD algorithms. Parallelization of nested loops 12. MIMD computers Multiprocessors and multicomputers. 13. Cache coherence. Snoopy protocols. Directory schemes. 14. Communication and process synchronization in MIMD systems: traffic lights, monitors, sending messages 15. Examples of algorithms for MIMD systems.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

El-Rewini,H., El-Barr, M.	„Advanced computer arhitecture and parallel processing“, John Wiley and Sons	2005	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Gonzalez, J. F.	Java 9 Concurrency Cookbook, Packt Publishing	2017	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	tests (optional)	10	10%
	homework (optional)	10	10%
	laboratory exercises	10	10%
	midterm exam I (optional)	20	20%
	midterm exam II (optional)	20	20%
	project (optional)	40	40%
	Final exam		
	final written exam (optional)	40	40%
	final oral exam	40	40%
	TOTAL	100	100%
Web page			
Certification date			

THIRD YEAR – ELECTIVE SUBJECTS

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	

Full name of the course	**CONTROLLERS AND INPUT – OUTPUT DEVICES**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-2-099-6	elective	VI	5.0

Teacher(s)	PhD Slobodan Lubura, full professor
Associate(s)	Nikola Kukrić, MSc, teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	$2*15*S_o$	$1*15*S_o$	$1*15*S_o$	1.5

total teaching workload (in hours, per semester) W= L*15 + AE *15 + LE *15 =60	total student workload (in hours, per semester) $T= L*15*S_o + AE*15*S_o + LE*15*S_o$ =90

Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester

Learning outcomes	Upon completion of the course the student will be able: 1. Demonstrate knowledge and understanding of the fundamental principles embedded systems design, explain the process and apply it. 2. Programming Arduino devices 3. Design simulations of Arduino and peripherals 4. Connect sensors, electronic components on development boards with Arduino. 5. Connect the Arduino to the PC computer and understand serial communication. 6. Demonstrate knowledge and understanding of the operation of digital sensors. 7. Demonstrate knowledge and understanding of the operation of analog sensors. 8. Design and implement a complete embedded system as a project.
Prerequisites	Prior knowledge of Fundamentals of Computer Techniques, Introduction to Programming and Programming Languages is required.
Teaching methods	• Interactive lectures and communication with students • Discussion and Group Works • Presentation • Homework • Project
Subject content per weeks	1. Introduction to embedded systems, introduction to the Arduino IDE, types of variables, functions, loops. 2. Configuration of digital pins, control of light emitting diodes. 3. Configuration of digital pins, reading input signals. Pull-up/Pull down resistors, interrupt/pulling technique. 4. Connection of LCD and 7-segment monitor. 5. Configuration of analog pins. AD conversion. 6. Arduino communications. UART/SPI/I2C. 7. Working with temperature sensors DHT22 and NTC.

	8. Operation with distance sensor and PIR sensor. 9. Working with photoresistors, buzzer. 10. Work with DC and servo motors. 11. Arduino control using the WFA application. 12. Introduction to ESP8266/ESP32 microcontrollers. 13. Microcontroller Internet Communications. 14. Implementation of a practical project. 15. Implementation of a practical project.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Simon Monk	Programming Arduino, Simon Monk	2020	all
Bert van Dam	Arduino Uno - 45 Projects for Beginners and Experts Paperback, Elektor International Media BV	2016	all

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Martin P. Bates	Interfacing PIC Microcontrollers Embedded Design by Interactive Simulation, Elsevier	2006	all

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	homework	10	10%
	lab. exercises/practical work	45	45%
	Project	40	40%
	midterm exams	-	-
	final exam (written/oral)	-	-
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	

Full name of the course	**DIGITAL SIGNAL PROCESSING**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-2-039-6	elective	VI	5,0

Teacher(s)	Mirjana Maksimović, PhD, Associate Professor
Associate(s)	/

Number of lessons/teaching workload (weekly)			**Individual student workload (hour per semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	0	45	45	0	1,5

Total teaching workload (in hours, per semester)	Total student workload (in hours, per semester)
60	90

Total workload of the subject (teaching + student): W + T = U_{opt} hours in semester
150

Learning outcomes	By mastering this subject, the student will: 1. acquire the fundamental theoretical and practical knowledge of digital signal processing (DSP); 2. become acquainted with digital signals in the frequency domain; 3. become familiar with digital filters and fundamental methods of their design; and 4. become acquainted with the implementation and areas of DSP applications.
Prerequisites	There are no prerequisites for enrolling the course. It is necessary to have prior knowledge of the following subjects: Theory of Electrical Circuits I and II, Mathematics, I, II and III, and Programming languages.
Teaching methods	Teaching is conducted in the form of lectures, auditory and laboratory exercises. Learning, tests and consultations.
Subject content per weeks	1. Fundamental terms. Sampling, quantization and coding. 2. Discrete signals and systems. Characteristics of discrete systems. 3. Analysis of signals and systems in the time domain. Convolution. Recursive and non-recursive systems. 4. Systems with infinite (IIR) and systems with finite (FIR) impulse response. 5. Z-transformation. Bilateral and unilateral z-transformation. Inverse z-transform. 6. Analysis of linear, time-invariant (LTI) systems using z-transformation. 7. Realization of discrete systems. 8. Frequency analysis of signals and systems. Fourier series and Fourier transform of discrete signals. Properties of the Fourier transform of discrete signals. 9. Signal measurement and reconstruction, Nyquist criterion. 10. Discrete Fourier transform. Spectral leakage. 11. Properties of the discrete Fourier transform. Algorithms for fast calculation of the Fourier transform (FFT algorithms). 12. Circular convolution. Block convolution. Signal processing in the frequency domain. 13. Frequency selective systems. Ideal and real characteristics of frequency selective systems. Transfer function and system frequency response. 14. Designing digital filters by arranging zeros and poles in the complex plane. 15.Least-squares FIR filters design. Realization of digital filters.

Compulsory literature

Author(s)	**Publication title, Publisher**	**Year**	**Pages (from-to)**
M. Maksimović	Lecture presentations		
R. G. Lyons	Understanding Digital Signal Processing, Pearson	2010.	
J. G. Proakis , D. G. Manolakis	Digital Signal Processing – Principles, Algorithms and Applications,	1996.	

	Prentice Hall		
Additional literature			
Author(s)	**Publication title, Publisher**	**Year**	**Pages (from-to)**
/	/	/	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	Attendance at lectures/exercises	5	5 %
	Seminar paper	10	10 %
	1st test	20	20 %
	2nd test	20	20 %
	Final exam		
	Final exam (written/oral)	45	45 %
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	

Full name of the course	**PROGRAMMING TECHNIQUES AND METHODS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-2-143-6	elective	VI	5,0

Teacher(s)	Danijel Mijić, PhD, Associate Professor
Associate(s)	Budimir Kovacević, MSc, Senior Teaching Assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	0	2	45	0	45	1,5

total teaching workload (in hours, per semester) W=60	total student workload (in hours, per semester) T=90

Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester

Learning outcomes	1. Knowledge of user interface programming techniques 2. Knowledge of concepts and technologies for the development of desktop applications 3. Skills in developing desktop applications with a graphical user interface 4. Ability to work independently and in a team on the development of desktop applications
Prerequisites	None
Teaching methods	lectures, laboratory exercises
Subject content per weeks	1. Introduction. Programming paradigms. 2. Programming user interfaces. 3. Programming graphical user interfaces (GUI). 4. Basics of programming applications for the Windows operating system. 5. Technologies for GUI development. 6. .NET Framework. Structure and components. 7. Windows Forms applications. Windows. Controls. 8. Events. Delegates. Lambda expressions. 9. Technologies for working with databases. 10. LINQ concepts and implementations. Entity Framework. 11. Windows Presentation Foundation applications. XML. XAML. Resources. 12. Windows Store applications. Universal applications. 13. Design templates for GUI. MVC, MVP, MVVM patterns. 14. Internationalization and localization of applications. 15. Preparing applications for installation.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Troelsen, A.	Pro C# and the .NET 4.5 Framework, Apress	2012	

Additional literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	attendance at lectures/exercises		
	homework	10	10%
	lab. exercises/practical work		
	midterm exams	60	60%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle | Third year of study	

Full name of the course	**SOFTWARE SPECIFICATION AND MODELLING**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-2-179-6	elective	VI	5,0

Teacher(s)	Vladimir Vujović, PhD, Associate Professor
Associate(s)	Miljan Sikimić, MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	0	45	45	0	1,5

total teaching workload (in hours, per semester) W=60	total student workload (in hours, per semester) T=90

Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester

Learning outcomes	By mastering this subject, students will: 1. understand the basic principles, concepts, methodologies and techniques of the object modeling of complex software systems based on a unified modeling language UML 2.0, 2. be able to analyze complex systems and specify requirements for the system and software, 3. be able to apply UML formalisms when modeling static and dynamic system and software behavior, 4. understand the available commercial tools for modeling software, making formal ones specification for the representation of: architecture, static and dynamic behavior of the system and software.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge of the subject: Object oriented programming.
Teaching methods	lectures, auditory exercises, team project
Subject content per weeks	1. Introduction to software specification and modeling. Overview of methods and techniques for OO design. 2. The basic model of the software system. Relation of requirement specification, design specification and implementation of software systems. 3. Object-oriented design using the UML unified modeling language. Fundamentals of software design, static and dynamic modeling. Basics of UML, structure, organization and meta-model. 4. Recapitulation of the basics of requirements engineering and design of Use-Case diagrams. 5. Class diagram (structure, states). 6. Diagram of classes (relations). 7. Diagram of objects. Activity diagram. 8. Sequence diagram. Cooperation diagram. 9. State diagram. 10. Diagram of the complex structure. Component diagram. 11. Diagram of communication (collaboration). Time diagram.

	12. Advanced UML modeling: interfaces, packages and physical architecture modeling. 13. Package diagram. Deployment diagram. 14. Network architecture diagram. Diagram of technological infrastructure. Modeling service oriented architectures. 15. Architectural and design patterns and their application in software system architecture modelling.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Pfleger, S. L., Atlee, J. M.	Software Engineering: Theory and Practice (fourth edition), Pearson	2009	
Booch, G.	Object-oriented Analysis and Design with Applications (third edition), Addison-Wesley	2007	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Wiegers, K., Beatty, J.	Software Requirements (third edition), Microsoft Press	2013	
Kendall, K. E., Kendall, J. E.	Systems Analysis and Design (eight edition), Prentice Hall	2011	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10%
	team project	40	40%
	final exam (written/oral)	50	50%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Third year of study	
Full name of the course	**DIGITAL SYSTEMS**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-2-180-6	elective	VI	5,0

Teacher(s)	Milomir Šoja, PhD, Full Professor
Associate(s)	Srđan Lale, PhD, Assistant Professor

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	0	2	45	0	45	1,5

total teaching workload (in hours, per semester) W=60	total student workload (in hours, per semester) T=90

Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester

Learning outcomes	By mastering this subject, the student will be able to: 1. Implement a specific logic function using standard logic gates. 2. Select the appropriate logical family for the realization of digital circuits, taking into account theirs realistic features. 3. Understand the operation of standard combinational circuits and designs complex combinational circuits. 4. Understand the operation of standard sequential circuits and designs complex sequential circuits. 5. Understand the operation and proper use of various memory circuits. 6. Understand the structure and principles of programming programmable digital circuits. 7. Use the Quartus II software package for simulation and design of digital systems using the VHDL programming language.
Prerequisites	To attend the class, students need prior knowledge of digital electronics (subjects: Electronics I and II, Digital Electronics), while in order to pass the exam it is necessary to score ≥50% points in each forms of knowledge testing.
Teaching methods	Lectures, laboratory exercises
Subject content per weeks	1. Student obligations and assessment. Introduction to digital systems. 2. Programmable logic devices - PLD. Division of PLD. PLD programming technologies. 3. Simple PLD - SPLD. Structure of the SPLD. Types of SPLD. 4. Complex PLD - CPLD. Programmable gate arrays - FPGA. 5. Designing with PLD. Design software with PLD. Quartus II software package. 6. VHDL programming language. 7. Designing combinational modules with FPGA - decoders, encoders. 8. Designing combinational modules with FPGA - multiplexers, demultiplexers. 9. Designing combinational modules with FPGA - arithmetic circuits. 10. Designing sequential modules with FPGA - latch, flip-flops. 11. Designing sequential modules with FPGA - registers. 12. Designing sequential modules with FPGA - counters. 13. Design of semiconductor memories with FPGA - ROM, RAM.

	14. Designing finite automata with FPGA. 15. Designing a system for data acquisition with FPGA.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
P. J. Ashenden	VHDL Tutorial, Elsevier Science (USA)	2004	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
V. A. Pedroni	Circuit Design with VHDL, third edition, The MIT Press	2020	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	homework	5	5%
	laboratory exercises/practical work	10	10%
	midterm exams I and II	25+25	25%+25%
	Final exam		
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

FOURTH YEAR – ELECTIVE SUBJECTS

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering ***Study program:*** *Computer Science and Informatics* First study cycle | Fourth year of study	

Full name of the course	**SOFTWARE DESIGN**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-2-181-7 RI-08-2-181-8	elective	VII, VIII	5,0

Teacher(s)	Vladimir Vujović, PhD, Associate Professor
Associate(s)	Miljan Sikimić, MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	45	22.5	22.5	1,5

total teaching workload (in hours, per semester) W=60	total student workload (in hours, per semester) T=90

Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester

Learning outcomes	By mastering this subject, students will: 1. gain theoretical knowledge and practical skills related to principles, methods and software tools to support the development of architecture and design of complex software systems, 2. be able to, in the development of complex software systems, notice and apply software forms, as well as to understand the advantages and disadvantages of applying the recommended software forms, 3. be qualified for the construction of complex software systems based on standardization software implementation, testing, verification and validation process, 4. gain the elements of teamwork (collaboration and collaborative tools), as well as principles of software project management.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge of the subjects: Object oriented programming, Specification and modeling of software.
Teaching methods	Lectures, auditory and laboratory exercises, team project
Subject content per weeks	1. Introduction to software architecture and design. Basic principles and methods of the software design. 2. Basic principles of model-managed software development. 3. Aspects of designing software systems: conceptual and technical design, decomposition and modularity, software architecture, styles and strategies. 4. Aspects of construction of software systems: organization and structure of software, elements of software solution, standards of construction and implementation of functionality. 5. Basic definitions and history of development of project patterns. Categories of project forms; Design forms; Architectural forms. 6. Review of forms. Advantages and disadvantages. Catalogs of project forms.

	7. Model-View-Controller architectural pattern. 8. Types of design patterns. Creation patterns: Abstract Factory, Builder, Singleton, Factory Method. 9. Structure patterns: Adapter, Bridge, Composite, Decorator, Facade, Proxy. 10. Patterns of behavior: Command, Observer, State, Strategy, Template method. 11. Software design using design patterns. Program refactoring products in accordance with the project forms. 10. Modularity of the software system. Coupling, cohesion, interfaces and connectors of software components. 13. Software construction process: construction methods and techniques, teamwork and team software development. 14. Standards, code quality and software testing. 15. Integration, verification and validation of software. Fundamentals of software quality control. Software documentation.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Pfleger, S. L., Atlee, J. M.	Software Engineering: Theory and Practice (fourth edition), Pearson	2009	
Gamma, E., Helm, R., Johnson, R., Vlissides, J.	Design Patterns: Elements of Reusable ObjectOriented Software, Addison-Wesley	1995	
Sarcar, V.	Java Design Patterns – A Tour with 23 Gang of Four Design Patterns in Java, Apress	2016	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Kendall, K. E., Kendall, J. E.	Systems Analysis and Design (eight edition), Prentice Hall	2011	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10%
	team project	40	40%
	Final exam		
	final exam (written/oral)	50	50%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Fourth year of study	
Full name of the course	**COMPUTER GRAPHICS**	

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-2-129-7 RI-08-2-129-8	elective	VII, VIII	5,0

Teacher(s)	Snježana Milinković, PhD, Assistant Professor
Associate(s)	Zorana Štaka, MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	1	1	45	22.5	22.5	1,5
total teaching workload (in hours, per semester) W=60			total student workload (in hours, per semester) T=90			
Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester						

Learning outcomes	1. Knowledge of the basic principles of computer graphics. 2. Understanding the basic algorithms used in computer graphics and independent implementation and usage. 3. Ability to independently generate/draw/model complex 2D objects. 4. Ability to independently generate/draw/model complex 3D objects
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge of the subjects: Fundamentals of computer technique, Algorithms and data structures.
Teaching methods	Lectures, auditory and laboratory exercises, practical work
Subject content per weeks	1. Introduction. Definition of computer graphics. Areas of application of computer graphics. Historical review. 2. Graphical systems - introduction to hardware and software components. 3. Graphical hardware. 4. Raster operations - definition of basic raster operations. 5. Rasterization - algorithms for rasterization of line. 6. Rasterization - algorithms for rasterization of circle, ellipse and circular arc. 7. Transformations - basic 2D transformations. 8. Transformations - basic 3D transformations, composition of transformations. 9. Clipping. 10. Projections. 11. Filling - raster surfaces. 12. Filling - vector surfaces. 13. Colors - definition and color models. 14. 2D view. 15. Rendering.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

P. Shirley, M. Ashikhmin, S. Marschner	Fundamentals of Computer Graphics, A K Peters/CRC Press	2009	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	activity/homework	5	5%
	midterm exam I (optional)	30	30%
	midterm exam II (optional)	30	30%
	Final exam		
	final written exam	60	60%
	final oral exam	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Fourth year of study	

Full name of the course	**ARTIFICIAL INTELLIGENCE**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-2-077-7 RI-08-2-077-8	elective	VII, VIII	5,0

Teacher(s)	PhD Marijana Ćosović, associate professor
Associate(s)	Zorana Štaka MSc, senior teaching assistant

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	0	45	45	0	1,5

total teaching workload (in hours, per semester) W=60	total student workload (in hours, per semester) T=90

Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester

Learning outcomes	By mastering this subject, the student will: 1. Be able to understand basic problems, possible solutions, and research directions in artificial intelligence 2. Be able to answer the questions: what artificial intelligence is, what are expert systems made of, what is knowledge engineering, and what formalisms are used to represent knowledge 3. Be able to recognize the problems of artificial intelligence and ways of solving them through algorithms from different areas of artificial intelligence that he has mastered 4. Be able to develop programs based on artificial intelligence techniques in modern programming languages (Lisp, Prolog, Java, C++, Python) 5. Be able to apply modern tools to solve problems of artificial intelligence
Prerequisites	There are no requirements for registering and listening to the course. Prior knowledge of the subjects 'Basics of computer technology' and 'Algorithms and data structures' are required.
Teaching methods	lectures, auditory exercises, laboratory exercises, seminar work, project
Subject content per weeks	1. Introduction. Definitions and fields of application of artificial intelligence and directions of research. 2. Definition, structure, and types of intelligent agents. Environment types. Application examples. 3. Programming languages of artificial intelligence. 4. Functional and logical programming paradigm. Programming language Lisp. Prolog programming language. 5. Troubleshooting and searching. Problem-solving using search algorithms. Formulation of the problem. 6. Basic search algorithms. Uninformed search algorithms. 7. Heuristic (informed) search algorithms.

	8. Presentation of knowledge. Knowledge attribute and knowledge base. Languages (formalisms) for knowledge representation. 9. Predicate logic. 10. Pattern matching and unification. Conclusion. Translation into clausal form. Resolution. 11. Production systems. AND/OR tree. Inference in production systems. Strategies for conflict resolution. Frames. Semantic networks. 12. Introduction and basic approaches to machine learning. Decision tree induction. Algorithm ID3. Genetic algorithms. Neural networks. 13. Uncertain knowledge and reasoning. Uncertain inference in production systems. 14. Planning. Green's formulation of planning. The STRIPS method. 15. Other areas of artificial intelligence.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Russell S.J., Norvig P.	Artificial Intelligence: A Modern Approach, 4th Global ed.	2020	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Lucci, S., Kopec, D.	Artificial Intelligence In the 21st Century, A Living Introduction (second edition), Mercury Learning and Information	2016	
Watson, M.	Practical Artificial Intelligence Programming with Java (third edition)	2008	
Raschka, S.	Python Machine Learning, Packt Publishing	2015	
Bowles, M.	Machine Learning in Python, Wiley	2015	
Witten, I. H., Frank, E.	Data Mining – Practical Machine Learning Tools and Techniques (second edition), Elsevier	2005	

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10 %
	homework	10	10 %
	lab. exercises/practical work	20	20 %
	midterm exams	20	20 %
	final exam (written/oral)	40	40 %
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Fourth year of study	

Full name of the course	**DATABASE SOFTWARE TOOLS**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-2-133-7 RI-08-2-133-8	elective	VII, VIII	5,0

Teacher	PhD Srđan Nogo- Associate professor
Associate	Marko Malović– teaching assistant

Fund of classes/teaching load (weekly)			**Individual student load (in semester hours)**			**Cofficient of student load S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	0	45	45	0	1,5

total teaching workload (in hours, per semester) W=60	total student workload (in hours, per semester) T=90

Total workload of the subject (teaching + student): In_{opt}= W + T = 150 hours per semester

Learning Outcomes	By mastering this subject, the student will be able to: 1. Uses current, advanced technologies and is familiar with complex principles of database administration and software tools that enable this. 2.Uses advanced SQL usage techniques 3. Perform complex operations on the administration of a concrete database in a production environment 4. Develop a WEB-based application that uses database resources
Conditionality	There are no requirements for registering and listening to the course. Required prior knowledge in the subjects: Databases
Teaching methods	Lectures (L), auditory exercises (AE) and laboratory exercises (LE)
Course content by Week	1. Introduction. Overview of basic database concepts - what are databases, DBMS, introduction to SQL. 2. Advanced techniques of using SQL, nested queries, correlated and uncorrelated queries. 3. Grouping and advanced grouping techniques, totals and summations, operations for working with sets 4. Triggers. Definition and types of triggers. Method and order of execution. Examples of trigger application 5. PL/SQL. Definition of PL/SQL language, procedural programming. 6. PL/SQL program development environment. Memorized procedures and their use from applications 7. Search optimization. Indexing and indexes. Query optimization 8. Security and database administration. Overview of basic approaches. 9. Security at the level of the database, DBMS, operating system, etc. Attacks. 10. Relational databases and their use from applications 11. Distributed databases, XML and relational databases. 12. Data Access Layer and tools for accessing the database from object-oriented applications. 13. Mapping object-oriented to relational data model. Mapping tools. 14. Other advanced themes and tools. Object-oriented and object-relational databases. 15. Web and databases. Spatial databases. OLAP and OLTP

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Nogo. S.	Basics of database systems 2, Faculty of Electrical Engineering, University of East Sarajevo	2022	

Additional literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**

Emasri, R., Navathe, S.	Fundamentals of Database Systems	2004	

	Type of student work-evaluation	Points	Percentage
Obligations, forms of knowledge testing and assessment	Pre-exam obligations		
	Attendance at lectures/exercises	5	5%
	Laboratory exercises	20	20%
	1. Colloquium	15	15%
	2. Colloquium	15	15%
	Final exam		
	Final exam (oral/ written)	45	45%
	TOTAL	100	100%
Date of certification			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Computer Science and Informatics*	
	First study cycle / Fourth year of study	

Full name of the course	**MANAGEMENT IN ENGINEERING PRACTICE**

Subject code	**Subject status**	**Semester**	**ECTS**
RI-08-2-047-7 RI-08-2-047-8	elective	VII, VIII	5

Teacher(s)	Nenad Marković, PhD, assistant professor
Associate(s)	Miodrag Forcan, PhD, assistant professor

Number of lessons/teaching workload (weekly)			**Individual student workload (in hours per a semester)**			**Student workload coefficient S_o**
L	**AE**	**LE**	**L**	**AE**	**LE**	**S_o**
2	2	0	45	45	0	1.5

total teaching workload (in hours, per semester) W=2*15+2*15+0*15=60 h	total student workload (in hours, per semester) T=2*15*S_o+2*15*S_o+0*15*S_o=90 h

Total workload of the subject (teaching + student): In_{opt}= W + T = 60+90 = 150 hours per semester

Learning outcomes	1. Basic knowledge about companies as business entities. 2. Knowledge related to design, consulting services and contractor engineering. 3. Knowledge related to the quality and financial feasibility of projects. 4. Specialist knowledge related to project control and management.
Prerequisites	There is no requirement for other subjects.
Teaching methods	Lectures, auditory exercises, seminar papers, tests.
Subject content per weeks	1. Introductory considerations. 2. The company as a business entity: company (objectives of the company; legal form of the company). 3. Company strategy, company organization, company culture. 4. Environment (goals; tax system; financial markets and sources of funds). 5. Principles of systems engineering: introductory considerations. Continuous design. 6. Preliminary design. Detailed design. 7. Contractor engineering (services of consulting companies, contractor engineering). 8. Responsibility of consultants, selection of consultants, price for consulting services, offer, contract. 9. Reengineering. The place and role of information technologies in reengineering. 10. Fundamentals of the quality system. Quality system and standards; Quality system documentation. 11. Financial feasibility of the project: introduction; financial possibilities of investors. 12. Project profitability, project financing. 13. Project management: introduction; project manager and organization; planning; cost estimates. 14. Project control; the team; documentation; approach to project implementation. 15. Tools and methods: introduction; basic elements of the project.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
P. Trott	Innovation management and new product development, Pearson, Sixth Edition	2017.	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
P. O'Connor	The Practice of Engineering Management: A New Approach, 1st Edition, Wiley	1994.	
Harvard Business Review	Harvard Business Review Manager's Handbook: The 17 Skills Leaders Need to Stand Out (HBR Handbooks), Harvard Business Review Press	2017.	

	Type of student work evaluation	**Points**	**Percentage**
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	10	10 %
	midterm exam	30	30 %
	final exam (written/oral)	60	60 %
	TOTAL	100	100 %
Web page			
Certification date			