UNIVERSITY OF EAST SARAJEVO
FACULTY OF ELECTRICAL ENGINEERING
EAST SARAJEVO

FIRST STUDY CYCLE
STUDY PROGRAM
AUTOMATION AND ELECTRONICS

East Sarajevo, 2023.

ORGANIZATIONAL UNIT	
Name of the organizational unit	Faculty of Electrical Engineering
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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

- AUTOMATION AND ELECTRONICS -

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				
AUTOMATION AND ELECTRONICS	Дипломирани инжењер електротехнике – 240 ECTS – Аутоматика и електроника	*Bachelor of science in Electrical Engineering –240 ECTS – Automation and Electronics*	7	**07.023-3899/09** from 22. 06. 2009.

QUALIFICATIONS STANDARD FOR THE STUDY PROGRAM: AUTOMATION AND ELECTRONICS

1. BASIC CHARACTERISTICS

Study cycle: *First study cycle*
Degree: *Academic*
Study program: *Automation and Electronics*

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

Bachelor of science in Electrical Engineering – 240 ECTS – Automation and Electronics

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 Automation and Electronics, 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

Teaching in the study program Automation and Electronics (hereinafter AE) at the Faculty of Electrical Engineering of the University of East Sarajevo is conducted according to the curricula from 2012. The study program includes two narrow scientific areas: Automation and robotics, Electronics and electronic systems.

The study program is designed to educate engineers who will get enough professional and practical knowledge to work in the profession, and at the same time to enable further education at appropriate master's or doctoral studies.

The contents of the subjects in the lower years of study in the AE study program are designed to provide students with the necessary knowledge in general educational and theoretical subjects. This knowledge will serve them to understand the basics of electronics, electronic systems, systems with built-in computer and specialized computer systems, as well as the control of systems based on the principles of physics, mathematics, electrical engineering, signals and system theory.

The contents of the subjects in the higher years of study are specially designed, so that they provide students with professional and practical knowledge in the mentioned narrower scientific and professional fields. During studies, especially in professional (specialist) courses, independent work is especially valued, participation in specific professional and development projects within individual laboratories is encouraged and students' abilities to solve problems are enhanced and developed.

Upon successful completion of studies on the AE study program, the student is able to apply scientific and professional achievements in the field of electrical engineering, electronics, electronic systems, systems with built-in computer and specialized computer systems, as well as control of industrial systems based on the principles of signals and system theory in professional work, as well as finding new achievements in multidisciplinary areas that rely on the application of defined areas.

1.2. Reasons for the existence of the qualification - justification

The purpose of this study program is the formation of highly educated personnel for the needs of the economy in the field of electrical engineering, automation and electronics. The current situation, development trends and the needs of the market for engineers in the field of automation and electronics served as the basis for defining the structure and content of the study program. When designing the AE 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.

The social justification for the existence of the study program stems from the need for further development of the profession in the field of automation and electronics in the Republic of Srpska – Bosnia and Herzegovina, and the surrounding area. The high-quality education offered by this study program is the foundation for independent and lifelong learning in the field of automation and electronics, which is one of the important elements that have recently been current and present on the labor market. Support for this study program is also in the function of raising the quality of education and improving electrical engineering, electronics, automation and computer science in the Republic of Srpska – B&H, as well as in the function of forming young engineering staff in the Republic of Srpska – B&H.

According to the mentioned, the goals of the AE study program at the Faculty of Electrical Engineering in East Sarajevo are:

- Respect the strategic decisions of the society in those domains that rely on the application of knowledge and skills and the scientific fields of automation and electronics,
- Ensure that the learning outcomes of this study program correspond to the market needs,
- Improve learning outcomes by introducing modern teaching methods, using appropriate laboratory equipment and modern software tools,
- Create conditions for student mobility,
- To achieve national and international cooperation in the implementation of the teaching process within the AE study program,
- To create opportunities for lifelong learning of students after completing their studies.

2. COMPETENCES / LEARNING OUTCOMES

Upon successful completion of studies in the AE study program, the student acquires general knowledge, skills and competencies in the field of electrical engineering, electronics, electronic systems, systems with built-in computer and specialized computer systems, as well as control of industrial systems based on the principles of physics, mathematics, electrical engineering, signals and system theory.

2.1. List of competencies at the qualification level

The general knowledge that a graduated engineer from the AE study program possesses includes:

- Basic knowledge of mathematics, physics, electrical engineering, automation, robotics, electronics and electronic systems, data transmission, computer technology and programming techniques,
- Basic knowledge of electromechanical energy conversion, basic principles of transmission and conversion of other forms of energy and other engineering disciplines,
- Knowledge of the connection of automation and electronics with the basic knowledge required for the development, design, manufacture and maintenance of automation and electronics systems,
- The ability to choose and apply appropriate methods in the development, design, manufacture and maintenance of automation and electronics systems, as well as drawing conclusions and testing hypotheses,
- The ability to work in various professional fields thanks to the acquired general, specialist and methodological competences during studies,
- Ability to use relevant literature, follow seminars and courses, acquire new knowledge and technologies, present the achieved work results to the professional public,
- Knowledge of standards, technical norms and regulations, as well as understanding the impact that automation and electronics systems, their operation and maintenance have on the environment,
- Ability to work individually and as a team, and to communicate with colleagues and the public about issues and problems related to the fields of automation and electronics.

The specialist knowledge that a graduated engineer from the AE study program possesses includes:

- Assessment of the importance of Maxwell's equations for the development of science in general, especially their basic role in electrical engineering,
- Recognition and understanding of problems that arise in practice in the field of electromagnetics,
- Realizes mathematical models of problems that arise in practice in the field of electromagnetics,

- Finding quick and economical solutions using the most modern calculation and design techniques in the field of electromagnetics,
- Understanding the importance of compliance with technical regulations and norms and legal regulations in this area of electrical engineering,
- Understanding the operation of voltage regulators and limiters,
- Understanding the operation of logic gates and the characteristics of logic families in which they are implemented,
- Designing simple electronic modules for powering electronic circuits,
- Designing specific circuits with operational amplifiers and analog comparators,
- Understanding the operation and proper use of components for galvanically isolated signal transmission,
- Designing astable multivibrators based on logic circuits, OP/AK and 555,
- Designing monostable multivibrators based on logic circuits, OP/AK and 555,
- Designing specific signal generators,
- Knowledge of the basics of classical theory of linear dynamic systems, control systems with feedback,
- Training students for the analysis and synthesis of servo systems as elements of complex control systems,
- Familiarization with the basic elements of the control loops, with different stability criteria of linear systems, basic linear control laws, evaluation of system behavior in transient and stationary regimes, etc.,
- Training students for the analysis and synthesis of linear and nonlinear dynamic control systems with feedback,
- Familiarization with methods of linearization of non-linear elements: static, differential, harmonic and stochastic, as well as with various stability criteria of non-linear systems, basic non-linear control laws, etc.
- Understanding the importance of applying power electronics converters, their functional and technical characteristics,
- Calculation of the parameters of a powerful circuit breaker in a specific application and the selection of a circuit breaker of the appropriate type and characteristics, as well as optimal ways of its tripping and protection,
- Selection of a converter for a specific application, with the appropriate topology and functional and technical characteristics,
- Designing the gate drivers and switching cells of the specific converter,
- Designing the basic parts of the control structures of the specific converter,
- Acquiring basic knowledge of transport processes,
- Analysis of thermal energy processes,
- Selection and design of thermal energy equipment,
- Automatic management of thermal energy devices and plants,
- Assembly and commissioning of thermal energy equipment and plants,
- Warranty and operational tests,
- Revitalization and reconstruction of devices and plants,
- Knowledge of the physical foundations, characteristics and structure of electrotechnical materials (semiconductors, conductors, superconductors, dielectrics, magnetics, etc.),
- Knowledge of the application of materials in various electrotechnical devices,
- The ability to apply the acquired knowledge of materials science in practical work,
- The ability to monitor, understand and apply the latest achievements in the field of new materials,
- Basic theoretical knowledge about linear digital control systems,
- Practical knowledge of linear digital control systems,

- The student will be able to check and verify the acquired knowledge from digital control systems by computer simulations,
- The student will be able to apply the acquired knowledge in the analysis and design of a concrete system with direct digital control,
- Understanding the operation of standard combinational circuits and designing complex combinational assemblies,
- Understanding the operation of standard sequential circuits and designing complex sequential circuits,
- Understanding the operation and proper use of different memory circuits,
- Understanding the operation and proper use of A/D and D/A converters,
- Understanding of the structure and programming principles of programmable digital circuits,
- Understanding the importance of proper control of power electronics converters,
- Selection of circuits for optimal driving and protection of semiconductor switches,
- Designing circuits for measuring the characteristic values of converters,
- Designing circuits for phase control of converters,
- Designing circuits for voltage/current control of choppers,
- Understanding the principles of inverter control,
- Understanding the principles of digital control of power electronics converters,
- Use of specialized software for designing control of converters,
- Understanding the basic trends and significance of the ongoing nanotechnological revolution,
- Familiarization with the latest research and perspectives in the field of nanoelectronics,
- Connecting previously acquired knowledge with the current development of nanotechnologies,
- Ability for independent professional work: selection and analysis of professional and scientific literature related to a certain aspect of nanotechnology research, as well as their presentation,
- Mastering the basic theoretical and practical knowledge of digital signal processing,
- Getting to know digital signals in the frequency domain,
- Getting to know digital filters and mastering the basic methods of their design,
- Familiarization with the implementation and areas of application of digital filters,
- Mastering the basic theoretical and practical knowledge from the analysis of continuous signals and systems in the time and frequency domain,
- Understanding the most general descriptions of systems, their classification and qualitative properties,
- Gaining insight into the overview of algorithms for the analysis of linear time-invariant systems in the time and complex domains,
- Familiarization with the concept of analog filtering,
- Familiarization with the working principles of transformers and rotary electrical machines,
- Ability to determine the parameters and characteristics of electrical machines,
- Familiarization with the principles of regulation and starting of electrical machines,
- Familiarization with the operation of electrical machines in the power system,
- Getting to know the basic elements of power plants,
- Mastering the basic procedures of analog and digital signal analysis,
- Mastering the basic procedures of linear and non-linear transmission systems,
- Mastering the principles of transmission of analog and digital signals in the basic and transposed range,
- Work in the laboratory and familiarization with practical communication systems,
- Acquiring basic theoretical knowledge about different optimization methods,
- Mastering the basic theoretical knowledge that is necessary for finding the optimal solution to a specific problem,
- Enabling the student to check and verify acquired knowledge through computer simulations,

- Enabling the student to apply the acquired knowledge in solving numerous problems in and outside the profession,
- Knowledge of the basic principles of system operation with a built-in computer (microprocessor/microcontroller),
- Designing, testing and implementing a hardware functional unit with (microprocessor/microcontroller) based on the given specification,
- Modeling, designing, testing and implementing simple application and system programs in symbolic machine language for a given microcomputer system,
- Modeling, designing, testing and implementing simple application and system programs in a high-level programming language for a given microcomputer system,
- Application of various methods of mathematical process analysis in engineering practice,
- Performing the synthesis of mathematical process models,
- Use of software tools MATLAB, SIMULINK and MAPLE for the implementation of developed mathematical models,
- Performing the exploitation of the results obtained from the model in engineering practice,
- Using different process identification methods,
- Using different methods of designing automation control systems,
- Use of MATLAB, SIMULINK and MAPLE software tools for process identification and automation control system design,
- Application of various methods of process identification and automation control system design in practice,
- Basic knowledge of computer process control,
- Knowledge for PLC programming,
- Knowledge related to the application of PLCs in industry,
- Knowledge related to PLC maintenance,
- Basic knowledge of remote monitoring and control systems,
- Getting to know the basic concepts of electronic communication systems,
- Acquiring fundamental knowledge about computer networks and their operation,
- Acquiring theoretical and practical knowledge about the concepts of data transmission in communication networks,
- Understanding of data acquisition systems, intelligent sensors and the concept of the Internet of Things (IoT),
- Understanding and developing the perception of measuring non-electric quantities using sensors, bearing in mind that the output signal of current or voltage must be in the form of standard signals,
- Understanding and differentiating sensors, as well as the technique of measuring non-electric quantities,
- Understanding the principles of operation and application,
- Understanding and application of binding schemes and adjustment of output quantities.

COMPETENCY MATRIX OF STUDY PROGRAM AUTOMATION AND ELECTRONICS	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 analyse and model different physical manifestations and entities, simple components, devices, and systems from the field of electrical engineering	X	X			
Independently conduct experiments, statistical processing of the experimental results, analyse and understand the experiments, formulate, and conduct conclusions to understand the processes, devices or systems	X	X	X	X	X
Chose and apply proper methods of analysis, modelling, simulation and optimization of complex components, devices and systems from the fields of automation, robotics, electronics and electronic systems		X	X	X	
Ability to apply acquired theoretical knowledge in practice			X	X	
Ability to apply standards, technical regulations, as well as to understand the influence of the components, devices and systems of automation and electronics, their operation and maintenance			X	X	X
Ability to successfully participate in various teams, to gain basic skills of leadership in the project teams			X	X	
Able to develop critical opinions, to identify and analyse problems, predict behaviour of the selected solution with clear outcome of good and/or bad choice			X	X	X
Able to use scientific and professional literature	X	X	X		
Specially trained for combination of basic knowledge from different scientific and professional areas, considering the specifics of the study program Automation and Electronics			X	X	X
Competent to apply theoretical and practical knowledge based on scientific principles for solving complex and real problems from practice			X	X	X
Completely trained for continuation of the scientific work, trained for publication of scientific and professional papers in scientific fields, such as automation, robotics, electronics and electronic systems		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/job 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 subjects important for the study of engineering	51 ECTS credits
− Mathematics - 1	7.0
− Mathematics - 2	7.0
− Mathematics - 3	6.0
− Numerical Mathematics	6.0
− Physics	6.5
− Application Software	3.0
− Introduction to Programming	5.5
− English Language - 1	2.0
− English Language - 2	2.0
− English Language - 3	2.0
− English Language - 4	2.0
− Introduction to Management	2.0
Fundamental subjects of engineering – compulsory	89 ECTS credits

Subject group	ECTS (minimum)
− Fundamentals of Electrical Engineering - 1	7.0
− Fundamentals of Electrical Engineering - 2	7.0
− Electric Circuits Theory - 1	5,0
− Electric Circuits Theory - 2	5,0
− Electromagnetics - 1	6,0
− Electromagnetics - 2	6,0
− Electrical Measurements	5,0
− Electronics - 1	6,0
− Electronics - 2	5,0
− Physical Fundamentals of Electronics	5.5
− Fundamentals of Computer Technique	5.5
− Transport Processes	4.5
− Material Physics	4.5
− Fundamentals of Telecommunications	5,0
− Programming Languages	6,0
− Object Oriented Programming	6,0
Fundamental subjects of engineering – optional	20 ECTS credits
− Signal and system analysis	5.0
− Data Transmission and Acquisition	5.0
− Electric Machines and Plants	5.0
− Management in Engineering Practice	5.0
Vocational subjects – compulsory	62 ECTS credits
− Digital Control Systems	7.0
− Impulse Electronics	5.0
− Digital Electronics	6.0
− Automatic Control Theory - 1	5.0
− Automatic Control Theory - 2	5.0
− Power Electronics Converters Control - 1	6.0
− Automatic Control Systems Design	6.0
− Optimal Solutions Theory	5.0
− Microprocessor Systems	5.0
− Computer Process Control	6.0
− Process Modeling and Simulation	6.0
Vocational subjects – optional	40 ECTS credits
− Power Electronics Converters Control – 2	5.0
− Electronic Measurements	5.0
− Digital Signal Processing	5.0
− Introduction to Nanosciences and Nanotechnologies	5.0
− Special Sensors and Industrial Measurements	5.0
− Modern mechatronic systems	5.0
− Process Identification	5.0
− Microprocessor Control of Electric Drives	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 Automation and Electronics

	UNIVERSITY OF EAST SARAJEVO - FACULTY OF ELECTRICAL ENGINEERING	
	Study program: **Automation and Electronics**	

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.	AE-08-1-001-1	Mathematics – 1	C	No	I	3	3	0	7.0
2.	AE-08-1-002-1	Physics	C	No	I	3	1	1	6.5
3.	AE-08-1-003-1	Fundamentals of Electrical Engineering – 1	C	No	I	3	2	1	7.0
4.	AE-08-1-004-1	Fundamentals of Computer Technique	C	No	I	2	0	2	5.5
5.	AE-08-1-005-1	Introduction to Management	C	No	I	2	0	0	2.0
6.	AE-08-1-007-1	English Language – 1	C	No	I	1	1	0	2.0
7.	AE-08-1-008-2	Mathematics – 2	C	No	II	3	3	0	7.0
8.	AE-08-1-009-2	Introduction to Programming	C	No	II	2	1	2	5.5
9.	AE-08-1-010-2	Fundamentals of Electrical Engineering – 2	C	No	II	3	2	1	7,0
10.	AE-08-1-011-2	Physical Fundamentals of Electronics	C	No	II	2	2	0	5.5
11.	AE-08-1-012-2	Application Software	C	No	II	0	0	2	3.0
12.	AE-08-1-013-2	English Language – 2	C	No	II	1	1	0	2.0
					IN TOTAL:	**25**	**16**	**9**	**60**
SECOND YEAR									
1.	AE-08-1-014-3	Mathematics – 3	C	No	III	3	2	0	6.0
2.	AE-08-1-015-3	Electric Circuits Theory – 1	C	No	III	2	2	0	5.0
3.	AE-08-1-016-3	Electrical Measurements	C	No	III	2	1	1	5.0
4.	AE-08-1-017-3	Electronics – 1	C	No	III	3	2	1	6.0
5.	AE-08-1-018-3	Programming Languages	C	No	III	2	1	1	6.0
6.	AE-08-1-019-3	English Language – 3	C	No	III	1	1	0	2.0
7.	AE-08-1-020-4	Numerical Mathematics	C	No	IV	2	2	1	6.0
8.	AE-08-1-021-4	Electric Circuits Theory – 2	C	No	IV	2	1	1	5.0
9.	AE-08-1-022-4	Electromagnetics – 1	C	No	IV	3	3	0	6.0
10.	AE-08-1-023-4	Electronics – 2	C	No	IV	2	1	1	5.0
11.	AE-08-1-024-4	Object Oriented Programming	C	No	IV	2	1	1	6.0
12.	AE-08-1-025-4	English Language – 4	C	No	IV	1	1	0	2.0
					IN TOTAL:	**25**	**18**	**7**	**60**
THIRD YEAR									
1.	AE-08-1-026-5	Electromagnetics – 2	C	No	V	2	2	0	5.0
2.	AE-08-1-093-5	Impulse Electronics	C	No	V	2	1	1	5.0
3.	AE-08-1-140-5	Automatic Control Theory – 1	C	No	V	2	2	0	5.0
4.	AE-08-1-177-5	Power Electronics Converters Control – 1	C	No	V	2	2	1	6.0

5.	AE-08-1-145-5	Transport Processes	C	No	V	2	2	0	4.5
6.	AE-08-1-154-5	Material Physics	C	No	V	2	2	0	4.5
7.	AE-08-1-032-6	Digital Control Systems	C	No	VI	3	2	1	7.0
8.	AE-08-1-033-6	Digital Electronics	C	No	VI	2	1	2	6.0
9.	AE-08-1-034-6	Automatic Control Theory – 2	C	No	VI	2	2	0	5.0
10.	AE-08-1-035-6	Project – 1	C	No	VI	0	0	2	2.0
11.	AE-08-2-xxx-6	Optional subject AE – 3.1	E	No	VI	2	2	0	5.0
12.	AE-08-2-xxx-6	Optional subject AE – 3.2	E	No	VI	2	2	0	5.0
					IN TOTAL:	**23**	**20**	**7**	**60**
		FOURTH YEAR							
1.	AE-08-1-041-7	Fundamentals of Telecommunications	C	No	VII	2	2	0	5.0
2.	AE-08-1-141-7	Optimal Solutions Theory	C	No	VII	2	2	0	5.0
3.	AE-08-1-043-7	Microprocessor Systems	C	No	VII	2	1	1	5.0
4.	AE-08-1-107-7	Process Modeling and Simulation	C	No	VII	2	1	2	6.0
5.	AE-08-1-045-7	Ferial Practice	C	No	VII	0	0	4	4.0
6.	AE-08-2-xxx-7	Optional subject AE – 4.1	E	No	VII	2	2	0	5.0
7.	AE-08-1-051-8	Automatic Control Systems Design	C	No	VIII	2	2	1	6.0
8.	AE-08-1-052-8	Computer Process Control	C	No	VIII	2	1	2	6.0
9.	AE-08-1-053-8	Project – 2	C	No	VIII	0	0	2	2.0
10.	AE-08-2-xxx-8	Optional subject AE – 4.2	E	No	VIII	2	2	0	5.0
11.	AE-08-2-xxx-8	Optional subject AE – 4.3	E	No	VIII	2	2	0	5.0
12.	AE-08-1-054-8	Final Paper	C	No	VIII	0	0	5	6.0
					IN TOTAL:	**18**	**15**	**17**	**60**

Elective courses Automation and Electronics									
		THIRD YEAR							
1.	AE-08-2-178-6	Power Electronics Converters Control – 2	E	No	VI	2	2	0	5.0
2.	AE-08-2-037-6	Electronic Measurements	E	No	VI	2	2	0	5.0
3.	AE-08-2-039-6	Digital Signal Processing	E	No	VI	2	2	0	5.0
4.	AE-08-2-147-6	Introduction to Nanosciences and Nanotechnologies	E	No	VI	2	2	0	5.0
5.	AE-08-2-040-6	Signals and Systems Analysis	E	No	VI	2	2	0	5.0
6.	AE-08-2-091-6	Electric Machines and Plants	E	No	VI	2	2	0	5.0
7.		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.	AE-08-2-046-7 AE-08-2-046-8	Data Transmission and Acquisition	E	No	VII VIII	2	2	0	5.0
2.	AE-08-2-047-7 AE-08-2-047-8	Management in Engineering Practice	E	No	VII VIII	2	2	0	5.0
3.	AE-08-2-048-7 AE-08-2-048-8	Special Sensors and Industrial Measurements	E	No	VII VIII	0	2	0	5.0
4.	AE-08-2-092-7 AE-08-2-092-8	Process Identification	E	No	VII VIII	2	2	0	5.0
5.	AE-08-2-105-7 AE-08-2-105-8	Microprocessor Control of Electric Drives	E	No	VII VIII	2	2	0	5.0

6.	AE-08-2-201-7 AE-08-2-201-8	Modern mechatronic systems	E	No	VII VIII	2	2	0	5.0
7.		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:*** *Automation and Electronics*		
	First study cycle	First year of study	
Full name of the course	**MATHEMATICS 1**		

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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: *Automation and Electronics*	
	First study cycle / First year of study	
Full name of the course	**PHYSICS**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)	total student workload (in hours, per semester)
W=3*15 + 1*15 +1*15=75h	$T=3*15*S_o+1*15*S_o+1*15*S_o$ = 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.	-

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	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:*** *Automation and Electronics* First study cycle | First year of study	
Full name of the course	**FUNDAMENTALS OF ELECTRICAL ENGINEERING – 1**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)	total student workload (in hours, per semester)
W= 3*15 + 2*15 + 1*15 =90 hours	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	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	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: *Automation and Electronics*	
	First study cycle / First year of study	

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

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)	total student workload (in hours, per semester)
W= 2*15 + 0*15 + 2*15 =60 hours	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			

<table>
<tr><td colspan="2"></td><td colspan="3">UNIVERSITY OF EAST SARAJEVO
Faculty of Electrical Engineering</td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="3">Study program: Automation and Electronics</td><td colspan="2"></td></tr>
<tr><td colspan="2"></td><td colspan="2">First study cycle</td><td>First year of study</td><td colspan="2"></td></tr>
<tr><td colspan="2">Full name of the course</td><td colspan="5">INTRODUCTION TO MANAGEMENT</td></tr>
<tr><td colspan="2">Subject code</td><td colspan="2">Subject status</td><td>Semester</td><td colspan="2">ECTS</td></tr>
<tr><td colspan="2">AE-08-1-005-1</td><td colspan="2">compulsory</td><td>I</td><td colspan="2">2</td></tr>
<tr><td>Teacher(s)</td><td colspan="6">Nenad Marković, asst. prof.</td></tr>
<tr><td>Associate(s)</td><td colspan="6">-</td></tr>
<tr><td colspan="3">Number of lessons/teaching workload (weekly)</td><td colspan="3">Individual student workload (in hours per a semester)</td><td>Student workload coefficient S_o</td></tr>
<tr><td>L</td><td>AE</td><td>LE</td><td>L</td><td>AE</td><td>LE</td><td>S_o</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>30</td><td>0</td><td>0</td><td>1</td></tr>
<tr><td colspan="3">total teaching workload (in hours, per semester)
W= 2*15= 30 h</td><td colspan="4">total student workload (in hours, per semester)
T= 2*15*S_o= 30 h</td></tr>
<tr><td colspan="7">Total workload of the subject (teaching + student): In_{opt}= W + T = 30 + 30 = 60 hours per semester</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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.</td></tr>
<tr><td>Prerequisites</td><td colspan="6">-</td></tr>
<tr><td>Teaching methods</td><td colspan="6">Presentations, Case studies</td></tr>
<tr><td>Subject content per weeks</td><td colspan="6">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</td></tr>
</table>

	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: *Automation and Electronics*		
	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)**

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			

<table>
<tr><td rowspan="4"></td><td colspan="2">UNIVERSITY OF EAST SARAJEVO
Faculty of Electrical Engineering</td><td rowspan="4"></td></tr>
<tr><td colspan="2">Study program: Automation and Electronics</td></tr>
<tr><td>First study cycle</td><td>First year of study</td></tr>
</table>

<table>
<tr><td>Full name of the course</td><td colspan="6">MATHEMATICS 2</td></tr>
<tr><td colspan="2">Subject code</td><td colspan="2">Subject status</td><td>Semester</td><td colspan="2">ECTS</td></tr>
<tr><td colspan="2">AE-08-1-008-2</td><td colspan="2">compulsory</td><td>II</td><td colspan="2">7,0</td></tr>
<tr><td>Teacher(s)</td><td colspan="6">Vidan Govedarica, PhD, full professor</td></tr>
<tr><td>Associate(s)</td><td colspan="6">Vidan Govedarica, PhD, full professor; Nataša Pavlović Komazec, PhD, assistant professor</td></tr>
<tr><td colspan="3">Number of lessons/teaching workload (weekly)</td><td colspan="3">Individual student workload (in hours per a semester)</td><td>Student workload coefficient S_o</td></tr>
<tr><td>L</td><td>AE</td><td>LE</td><td>L</td><td>AE</td><td>LE</td><td>S_o</td></tr>
<tr><td>3</td><td>3</td><td>0</td><td>60</td><td>60</td><td>0</td><td>1.33</td></tr>
<tr><td colspan="3">total teaching workload (in hours, per semester)
W= 3*15 + 3*15 + 0*15 =90 h</td><td colspan="4">total student workload (in hours, per semester)
T= = 3*15*S_o + 3*15*S_o + 0*15*S_o = 120 h</td></tr>
<tr><td colspan="7">Total workload of the subject (teaching + student): In_{opt}= W + T = 90 + 120 = 210 hours per semester</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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.</td></tr>
<tr><td>Prerequisites</td><td colspan="6">There are no special requirements for taking courses and taking exams.</td></tr>
<tr><td>Teaching methods</td><td colspan="6">The teaching process is realized mainly through a frontal form of work - lectures and an interactive form of work - auditory exercises.</td></tr>
<tr><td>Subject content per weeks</td><td colspan="6">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.</td></tr>
</table>

	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	

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 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: *Automation and Electronics*		
	First study cycle	First year of study	
Full name of the course	**INTRODUCTION TO PROGRAMMING**		

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)	total student workload (in hours, per semester)
W= 2*15 + 1*15 + 2*15 =75 h	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: *Automation and Electronics*					
	First study cycle		First year of study			
Full name of the course	**FUNDAMENTALS OF ELECTRICAL ENGINEERING – 2**					
Subject code		**Subject status**		**Semester**		**ECTS**
AE-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	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	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: *Automation and Electronics*	
	First study cycle / Firstyear of study	
Full name of the course	**PHYSICAL FUNDAMENTALS OF ELECTRONICS**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)**

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	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:*** *Automation and Electronics* First study cycle | First year of study	
Full name of the course	**APPLICATION SOFTWARE**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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: *Automation and Electronics*		
	First study cycle	First year of study	
Full name of the course	**ENGLISH LANGUAGE 2**		

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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: *Automation and Electronics*		
	First study cycle	Second year of study	
Full name of the course	**MATHEMATICS 3**		

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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	

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 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: *Automation and Electronics*	
	First study cycle / Second year of study	

Full name of the course	**ELECTRIC CIRCUITS THEORY – 1**

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)	total student workload (in hours, per semester)
W= 2*15 + 2*15 + 0*15 =60 h	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:*** *Automation and Electronics* First study cycle — Second year of study	
Full name of the course	**ELECTRICAL MEASUREMENTS**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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.

<table>
<tr><th colspan="4">Compulsory literature</th></tr>
<tr><th>Author(s)</th><th>Publication title, publisher</th><th>Year</th><th>Pages (from-to)</th></tr>
<tr><td>Prithwiraj Purkait, Budhaditya Biswas, Santanu Das, Chiranjib Koley</td><td>Electrical and Electronics Measurements and Instrumentation, McGraw Hill Education, New Delhi.</td><td>2013</td><td>-</td></tr>
<tr><td>Alan S. Morris, Reza Langari.</td><td>Measurement and Instrumentation - Theory and Application, Academic Press - Elsevier.</td><td>2016</td><td></td></tr>
<tr><td>V. Radenković, V. Milenković</td><td>Električna mjerenja, EF Niš, ETF I. Sarajevo</td><td>2004</td><td></td></tr>
<tr><td>S. Damjanović, M. Banjanin, M. Ćosović, M. Forcan</td><td>Praktikum za laboratorijske vježbe iz električnih mjerenja, ETF I. Sarajevo</td><td>2016</td><td></td></tr>
<tr><th colspan="4">Additional literature</th></tr>
<tr><th>Author(s)</th><th>Publication title, publisher</th><th>Year</th><th>Pages (from-to)</th></tr>
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<tr><td rowspan="11">Obligations, forms of knowledge assessment and grading</td><th>Type of student work evaluation</th><th>Points</th><th>Percentage</th></tr>
<tr><td colspan="3">Pre-examination obligations</td></tr>
<tr><td>attendance at lectures/exercises</td><td>5</td><td>5%</td></tr>
<tr><td>I partial exam (colloquia)</td><td>20</td><td>20%</td></tr>
<tr><td>II partial exam (colloquia)</td><td>20</td><td>20%</td></tr>
<tr><td>laboratory exercises</td><td>15</td><td>15%</td></tr>
<tr><td>seminar paper</td><td>10</td><td>10%</td></tr>
<tr><td colspan="3">Final exam</td></tr>
<tr><td>test paper</td><td>15</td><td>15%</td></tr>
<tr><td>oral examination</td><td>15</td><td>15%</td></tr>
<tr><td>TOTAL</td><td>100</td><td>100%</td></tr>
<tr><td>Web page</td><td colspan="3"></td></tr>
<tr><td>Certification date</td><td colspan="3"></td></tr>
</table>

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	Firs study cycle / Second year of study	

Full name of the course	**ELECTRONICS 1**

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)	total student workload (in hours, per semester)
W=3*15 + 2*15 + 1*15 = 90 h	$T=3*15*S_o + 2*15*S_o + 1*15*S_o$ = 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	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	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: *Automation and Electronics*	
	First study cycle / Second year of study	

Full name of the course	**PROGRAMMING LANGUAGES**

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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	-

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%
	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: *Automation and Electronics*	
	First study cycle / Second year of study	
Full name of the course	**ENGLISH LANGUAGE 3**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)	total student workload (in hours, per semester)
W=1*15 + 1*15 + 0*15= 30 h	$T=1*15*S_o + 1*15*S_o + 0*15*S_o = 30$ 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: *Automation and Electronics*	
	First study cycle / Second year of study	

Full name of the course	**NUMERICAL MATHEMATICS**

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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.	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	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: *Automation and Electronics*	
	First study cycle / Second year of study	

Full name of the course	**ELECTRIC CIRCUITS THEORY – 2**

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)	total student workload (in hours, per semester)
W= 2*15 + 1*15 + 1*15 =60 h	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	-

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 exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	First study cycle / Second year of study	
Full name of the course	**ELECTROMAGNETICS - 1**	

Subject code	Subject status	Semester	ECTS
AE-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: *Automation and Electronics*	
	Firs study cycle / Second year of study	
Full name of the course	**ELECTRONICS 2**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)	total student workload (in hours, per semester)
W=2*15 + 1*15 + 1*15 = 60 h	$T=2*15*S_o + 1*15*S_o + 1*15*S_o = 90$ 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.

<table>
<tr><td></td><td>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.</td></tr>
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<table>
<tr><th colspan="4">Compulsory literature</th></tr>
<tr><th>Author(s)</th><th>Publication title, publisher</th><th>Year</th><th>Pages (from-to)</th></tr>
<tr><td>A. S. Sedra, K. C. Smith</td><td>Microelectronics Circuits, Sounders College Publishing</td><td>1991</td><td></td></tr>
<tr><th colspan="4">Additional literature</th></tr>
<tr><th>Author(s)</th><th>Publication title, publisher</th><th>Year</th><th>Pages (from-to)</th></tr>
<tr><td>G. McWhorter, A. J. Evans</td><td>Basic Electronics, Master Publishing, Inc.</td><td>2004</td><td></td></tr>
</table>

<table>
<tr><td rowspan="8">Obligations, forms of knowledge assessment and grading</td><th>Type of student work evaluation</th><th>Points</th><th>Percentage</th></tr>
<tr><td colspan="3">Pre-examination obligations</td></tr>
<tr><td>attendance at lectures/exercises</td><td>5</td><td>5%</td></tr>
<tr><td>midterm exams</td><td>35</td><td>35%</td></tr>
<tr><td>lab. exercises/practical work</td><td>10</td><td>10%</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>final exam (written/oral)</td><td>50</td><td>50%</td></tr>
<tr><td>TOTAL</td><td>100</td><td>100%</td></tr>
<tr><td>Web page</td><td colspan="3"></td></tr>
<tr><td>Certification date</td><td colspan="3"></td></tr>
</table>

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering		
	Study program: *Automation and Electronics*		
	First study cycle	Second year of study	
Full name of the course	**OBJECT-ORIENTED PROGRAMMING**		

Subject code	**Subject status**	**Semester**	**ECTS**
AE-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)**

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	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			

<table>
<tr><td colspan="2"></td><td colspan="3">UNIVERSITY OF EAST SARAJEVO
Faculty of Electrical Engineering</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="3">Study program: Automation and Electronics</td><td></td></tr>
<tr><td colspan="2"></td><td>First study cycle</td><td colspan="2">Second year of study</td><td></td></tr>
<tr><td colspan="2">Full name of the course</td><td colspan="4">ENGLISH LANGUAGE 4</td></tr>
</table>

<table>
<tr><th>Subject code</th><th>Subject status</th><th>Semester</th><th>ECTS</th></tr>
<tr><td>AE-08-1-025-4</td><td>compulsory</td><td>IV</td><td>2</td></tr>
</table>

<table>
<tr><td>Teacher(s)</td><td colspan="6">Darko Kovačević, PhD, associate professor</td></tr>
<tr><td>Associate(s)</td><td colspan="6"></td></tr>
<tr><th colspan="3">Number of lessons/teaching workload (weekly)</th><th colspan="3">Individual student workload (in hours per a semester)</th><th>Student workload coefficient S_o</th></tr>
<tr><th>L</th><th>AE</th><th>LE</th><th>L</th><th>AE</th><th>LE</th><th>S_o</th></tr>
<tr><td>1</td><td>1</td><td>-</td><td>15</td><td>15</td><td>-</td><td>1</td></tr>
<tr><td colspan="3">total teaching workload (in hours, per semester)
W=1*15 + 1*15 + 0*15 = 30 h</td><td colspan="4">total student workload (in hours, per semester)
$T=1*15*S_o + 1*15*S_o + 0*15*S_o = 30$ h</td></tr>
<tr><td colspan="7">Total workload of the subject (teaching + student): In_{opt}= W + T = 30 + 30 = 60 hours per semester</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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.</td></tr>
<tr><td>Prerequisites</td><td colspan="6">There are no special requirements for taking courses and taking exams.</td></tr>
<tr><td>Teaching methods</td><td colspan="6">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</td></tr>
<tr><td>Subject content per weeks</td><td colspan="6">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.</td></tr>
</table>

<table>
<tr><th colspan="4">Compulsory literature</th></tr>
<tr><th>Author(s)</th><th>Publication title, publisher</th><th>Year</th><th>Pages (from-to)</th></tr>
<tr><td>D. Kovačević</td><td>Collection of texts for English Language 4 with exercises and assignments</td><td>2019</td><td></td></tr>
<tr><th colspan="4">Additional literature</th></tr>
<tr><th>Author(s)</th><th>Publication title, publisher</th><th>Year</th><th>Pages (from-to)</th></tr>
</table>

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

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			

THIRD YEAR – COMPULSORY SUBJECTS

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	***Study program:** Automation and Electronics*	
	First study cycle / Third year of study	
Full name of the course	**ELECTROMAGNETICS - 2**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-026-5	compulsory	V	5

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**
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 in semester						

Learning outcomes	By mastering this subject, the student will be able to: 1. evaluate the importance of Maxwell's equations 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 updating knowledge, 6. 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, Mathematics I, II and III and Electromagnetics -1.
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. Time-varying fields. Quasi-stationary magnetic fields, 2. Own and mutual inductances. Quasi-stationary field energy. 3. Inductances of a two-wire line, coaxial cable, one phase of a three-phase line and mutual inductance of two parallel two-wire lines. 4. Maxwell's equations. Continuity equation, Maxwell's equations for stationary media. 5. Characteristics of Maxwell's equations. Vorticity and origin of the field of vectors E, D, H, and B 6. Boundary conditions and the law of refraction. Potential matching. Hertz's potential. 7. Complex vectors. 8. Complex form of Maxwell's equations. Pointing's theorem 9. Complex Pointing vector, the mean value of the Pointing vector.

<table>
<tr><td></td><td colspan="5">10. Propagation of electromagnetic waves.
11. Uniform waves in a homogeneous dielectric.
12. A plane wave in a homogeneous conductive medium (cases of a good, ideal conductor and a real dielectric.
13. Reflection and refraction of plane waves, Standing waves.
14. Reflection and refraction of waves whose direction of propagation is normal to the separating plane
15. Reflection and refraction of waves whose direction of propagation is at an arbitrary angle to the plane of separation. Fresnel coefficients. Snell's law. Snell's law in complex form.</td></tr>
<tr><td colspan="6">Compulsory literature</td></tr>
<tr><td colspan="2">Author(s)</td><td>Publication title, publisher</td><td>Year</td><td colspan="2">Pages (from-to)</td></tr>
<tr><td colspan="2">Božidar M. Krstajić</td><td>Electromagnetics with a methodical collection of tasks, Faculty of Electrical Engineering, University of East Sarajevo</td><td>2016.</td><td colspan="2">285 to 443</td></tr>
<tr><td colspan="6">Additional literature</td></tr>
<tr><td colspan="2">Author(s)</td><td>Publication title, publisher</td><td>Year</td><td colspan="2">Pages (from-to)</td></tr>
<tr><td colspan="2">Antonije R. Đorđević</td><td>Electromagnetics, Academic Thought and ETF Belgrade</td><td>2008.</td><td colspan="2"></td></tr>
<tr><td colspan="2">B. Notaroš, V. Petrović, M. Ilić, A. Đorđević, B. Kolundžija, M. Dragović</td><td>A collection of exam questions and assignments from Electromagnetics, ETF Belgrade and Academic Thought</td><td>2002.</td><td colspan="2"></td></tr>
<tr><td rowspan="8">Obligations, forms of knowledge assessment and grading</td><td colspan="3">Type of student work evaluation</td><td>Points</td><td>Percentage</td></tr>
<tr><td colspan="5">Pre-examination obligations</td></tr>
<tr><td colspan="3">attendance at lectures/exercises</td><td>10</td><td>10%</td></tr>
<tr><td colspan="3">midterm exam I</td><td>30</td><td>30%</td></tr>
<tr><td colspan="3">midterm exam II</td><td>30</td><td>30%</td></tr>
<tr><td colspan="5"></td></tr>
<tr><td colspan="3">final exam (written/oral)</td><td>30</td><td>30%</td></tr>
<tr><td colspan="3">TOTAL</td><td>100</td><td>100 %</td></tr>
<tr><td>Web page</td><td colspan="5"></td></tr>
<tr><td>Certification date</td><td colspan="5"></td></tr>
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	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	First study cycle / Third year of study	

Full name of the course	**IMPULSE ELECTRONICS**

Subject code	Subject status	Semester	ECTS
AE-08-1-093-5	compulsory	V	5

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	1	1	$2*15*S_o$	$1*15*S_o$	$1*15*S_o$	1.5

total teaching workload (in hours, per semester) W=2*15+1*15+1*15=60	total student workload (in hours, per semester) $T=2*15*S_o+1*15*S_o+1*15*S_o=90$
Total workload of the subject (teaching + student): In_{opt}= W + T = 60+90 = 150 hours per semester	

Learning outcomes	Upon successful completion of the course the students will be able to: 1. Undestand and analyze voltage limiters and voltage shaper, 2. Undestand logic gates modes and logic families characteristics, 3. Design basic electronic circuits power supplies, 4. Design typical Operational amplifiers/Analog comparators (OA/AC) circuits, 5. Undestand and correctly uses of components for galvanic isolation signal transmitting 6. Design astable multivibrators based on logic gates, OA/AC and 555 timers, 7. Design monostable multivibrators based on logic gates, OA/AC and 555 timers and 8. Design special types of generators
Prerequisites	For enrollment in Impulse electronics course, students should have basic electronic knowledge (from courses: Electronics I and II). 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: RC circuit*** **1.2** Voltage limiters and voltage shaper with RC circuits and diodes. ***Module: Logic gates*** **2.** Logic functions and logic gates **3.** Implementations of logic gates. Logic families- CMOS. ***Module: Power supply of electrical circuits*** **4.** Power supply of electronic circuits using AC voltage. **5.** Power supply of electronic circuits- negative voltage and double voltage. ***Module: Operational amplifiers (OA) circuits*** **6.** Operational amplifiers- typical circuits. ***Module: Analog comparators (AC)*** **7.** Analog comparators. Schmitt triggers. ***Module: Galvanic isolation signal transmitting*** **8.** Galvanic isolation measurements and signal transmitting. ***Module: Astable multivibrator*** **9.** Astable multivibrator with logic circuits and OA/AC.

	10. Astable multivibrator with logic circuits and OA/AC. ***Module: Monostable multivibrator*** **11.** Monostable multivibrator with logic circuits and OA/AC. **12.** Monostable multivibrator with logic circuits and OA/AC. ***Module: Special types of generators*** **13.1** Ramp generator. Square wave generator. **13.2** Frequency doubler circuits. Voltage controller oscillators. ***Module: Timers*** **14.** Timers. 555 timer circuits. **15.** 555 timer circuits.

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)**
Paul Horowitz, Winfield Hill	The Art of Electronics, Second Editiopn, Cambridge University Press	1999.	
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			

<table>
<tr><td rowspan="3"></td><td colspan="2">UNIVERSITY OF EAST SARAJEVO
Faculty of Electrical Engineering</td><td rowspan="3"></td></tr>
<tr><td colspan="2">Study program: Automation and Electronics</td></tr>
<tr><td>First study cycle</td><td>Third year of study</td></tr>
<tr><td>Full name of the course</td><td colspan="3">AUTOMATIC CONTROL THEORY – 1</td></tr>
</table>

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-140-5	compulsory	V	5

Teacher(s)	Marko Bošković, Assistant professor
Associate(s)	Marko Bošković, Assistant professor

<table>
<tr><th colspan="3">Number of lessons/teaching workload (weekly)</th><th colspan="3">Individual student workload (in hours per a semester)</th><th>Student workload coefficient S_o</th></tr>
<tr><th>L</th><th>AE</th><th>LE</th><th>L</th><th>AE</th><th>LE</th><th>S_o</th></tr>
<tr><td>2</td><td>2</td><td>0</td><td>45</td><td>45</td><td>0</td><td>1.5</td></tr>
<tr><td colspan="3">total teaching workload (in hours, per semester)
W=2*15 + 2*15 + 0*15 =60 hours</td><td colspan="4">total student workload (in hours, per semester)
$T = 2*15*S_o + 2*15*S_o + 0*15*S_o = 90$ hours</td></tr>
<tr><td colspan="7">Total workload of the subject (teaching + student): $In_{opt} = W + T = 60+90 = 150$ hours per semester</td></tr>
</table>

<table>
<tr><td>Learning outcomes</td><td>The course aims to:
1. teach students classic theory of linear time-invariant systems, closed-loop control systems.
2. teach students analysis and synthesis of servosystems as elements of more complex control systems.
3. teach students fundamental elements of control loops with different stability criterions of linear systems, linear control laws, evaluation of the behavior of the system in transient and stationary regimes, etc.
4. with the acquired knowledge, create a basis for further study of control theory-based teaching courses.</td></tr>
<tr><td>Prerequisites</td><td>There are no prerequisites for enrolling the course.
It is necessary to have prior knowledge of the following subjects:
Mathematics - 1, Mathematics - 2, Mathematics - 3, Physics and Electric Circuits Theory.</td></tr>
<tr><td>Teaching methods</td><td>Teaching is conducted in the form of lectures, auditory and demonstration exercises on the computer.
The colloquium and the written part of the exam are taken in written form, while the oral part of the exam is taken orally. The final grade of the exam will be based on the success of the colloquium, the written part and the oral part of the exam. The Moodle platform is used for creating the content of teaching units, storing teaching materials and results of pre-examination obligations and final examinations, as well as for communication with students.</td></tr>
<tr><td>Subject content per weeks</td><td>1. Introduction. Simple control structure and its functional elements. Examples.
2. Mathematical models of elements and systems. Electromechanical analogies.
3. Transfer function of linear electrical networks.
4. Description of the elements of the control loop: actuators, measuring elements, amplifiers, etc.
5. Responses of elements and systems. Characteristic responses: impulse, step, parabolic.
6. Frequency response of the system and methods for graphical representation.
7. Processes in linear systems. Stability of linear systems. Routh and Hurwitz stability criterion.
8. Frequency stability criteria. Mikhailov stability criterion.</td></tr>
</table>

	9. Nyquist stability criterion. Tsypkin intersection rule. Bode's criterion. 10. Evaluation of the quality of behavior of linear systems. Error constants. 11. Assessment of system behavior in transient regimes. 12. The root-locus method of Evans-Teodorchik. 13. Integral criteria of system quality. Sensitivity. Robustness. Invariance. 14. Synthesis of compensators and simple control loops. Synthesis of differential compensator. 15. Synthesis of integral and differential-integral compensator and PI/PID controller.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
K. Ogata	Modern control engineering, Fifth edition, Prentice Hall	2010.	
R.C. Dorf, R.H. Bishop	Modern control systems, Pearson Prentice Hall	2008	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
K.J. Åström, R.M. Murray	Feedback systems, Princeton University Press	2008.	
G.F. Franklin, J.D. Powell, A. Emami-Naeini, J.D. Powell	Feedback control of dynamic systems (Vol. 4), Upper Saddle River: Prentice hall	2002.	
D. Xue, Y. Chen, D.P. Atherton	Linear feedback control: analysis and design with MATLAB. Society for Industrial and Applied Mathematics.	2007.	

	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	25	25%
	midterm exam II	25	25%
	final exam (written/oral)	45	45%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering ***Study program:*** *Automation and Electronics* First study cycle | Third year of study	
Full name of the course	**POWER ELECTRONICS CONVERTERS CONTROL 1**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-177-5	compulsory	V	6

Teacher(s)	Prof. dr Milomir Šoja, full professor
Associate(s)	MSc Marko ikić, 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	$2*15*S_o$	$2*15*S_o$	$1*15*S_o$	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 = 75+105 = 180 hours per semester						

Learning outcomes	Upon successful completion of the course the students will be able to: 1. Understand the importance usage of power converters, their functional and technical characteristics, 2. Calculate the parameters of the power switching device in the specific application and select the switching device with calculated specification, and optimal trigger methods and protection, 3. Select the converter for the specific application, with the appropriate topology and functional and technical characteristics, 4. Design power stage of specific power converter, 5. Design basic control structure components of a particular converter.
Prerequisites	Prerequisites require knowledge of fundamental of electrical engineering, circuit theory and electronics (courses: Fundamentals of Electrotechnics I and II, Circuits Theory I and II, Electronics I and II), while passing the exam requires ≥50% points in each forms of knowledge assessment.
Teaching methods	Lectures, auditory practical lectures, labs.
Subject content per weeks	***Modul: Introduction*** **1.1** Student obligations and assessments. **1.2** Introduction in PE: Definition of PE, significance and application. Power converters, general characteristics and classification. ***Modul: Power electronics components*** **2.1** Ideal and real power switching devices: characteristics and models. **2.2** Power semiconductor devices: Diode, thyristor, MOSFET, IGBT - characteristics. Trigger methods and its protection. ***Modul: AC-AC converters*** **3.1** Single-Phase AC-AC Voltage Controller: Topologies. Work principles. **3.2** Three-Phase AC-AC Voltage Controller: Topologies. Work principles. **4.** Control of AC-AC Converters: Phase control of voltage regulators. ***Modul: AC-DC converters (rectifiers)*** **5.** Single-Phase Rectifiers: Topologies. Work principles. **6.** Three-Phase Rectifiers: Topologies. Work principles. **7.** Control of AC-DC Converters: Phase control of rectifiers.

	Modul: DC-DC converters (choppers) **8.1** Introduction to DC-DC converters: Basic principle of DC-DC conversion. Classification of DC-DC converter. **8.2** Non-insulated DC-DC converters: buck and boost converter. **9.** Buck-boost, Cuk, half and full bridge converter. **10.** Insulated DC-DC converters: forward, flyback, insulated half and full bridge, push-pull converter. **11.** Control of DC-DC converters: PWM. Voltage and current control. **12.** Resonant DC-DC converters: Topologies, work principles and control of resonant DC-DC converters. ***Modul: DC-AC converters (inverters)*** **13.1** Introduction to DC-AC converters: AC voltage output types and its quality indicators. Harmonic filtering. **13.2** Single-Phase inverters: Topologies. Work principles. **14.1** Three-Phase inverters: Topologies. Work principles. **14.2** Multi-level inverters: Topologies. Work principles. **14.3** Control of inverters: AC output voltage creation. Sinus PWM. Bipolar and unipolar modulation. **15.1** Current inverters: Topologies. Work principles. Control of current inverters. **15.2** Resonant inverters: Topologies. Work principles. Control of resonant inverters.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
B. L. Dokić, B. Blanuša	POWER ELECTRONICS: Converters and Regulators, Springer	2015.	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
N. Mohan	POWER ELECTRONICS: A First Course, John Wiley & Sons	2012.	
Erickson, R. W., Maksimović, D.	Fundamental of Power Electronics, Springer Science+Business Media, LCC	2001.	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	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: *Automation and Electronics*	
	First study cycle / Third year of study	

Full name of the course	**TRANSPORT PROCESSES**

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-145-5	compulsory	V	4,5

Teacher(s)	Dušan Golubović, PhD, full professor
Associate(s)	Davor Milić, 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	37.5	37.5	0	1.25

total teaching workload (in hours, per semester)	total student workload (in hours, per semester)
W=2*15+2*15+0*15=60	$T=2*15*S_o+2*15*S_o+0*15*S_o=75$

Total workload of the subject (teaching + student): In_{opt}= W + T = 60+75 = 135 hours per semester

Learning outcomes	1. Acquisition of basic knowledge of transport processes 2. Analysis of thermal energy processes 3. Selection and design of thermal energy equipment 4. Automatic management of thermal energy devices and plants 5. Assembly and commissioning of thermal energy equipment and plants 6. Warranty and operational tests 7. Revitalization and reconstruction of devices and plants.
Prerequisites	Required prior knowledge of the subjects Mathematics I and II, Physics.
Teaching methods	Lectures, auditory exercises, tests, assignments, consultations, company visits, colloquiums, final exam.
Subject content per weeks	1.Physical and mathematical foundations of transferring the amount of movement, heat and substance. 2.Dimensional analysis and modelling. 3.Laws of conservation in fluid mechanics. 4.Laminar and turbulent fluid flow. 5.Applied fluid mechanics and methods. 6.Simple and complex pipelines. 7. Pumps, turbines, fans. Selection and installation in systems. 8. Heat transfer by conduction. 9.Heat transfer (convection). Laws of similarity. 10. Forced and natural convection. 11. Heat transfer by radiation between bodies. 12. Phase change mechanism. Evaporation and condensation. 13. Moist air. Basic processes. Dryers. 14. Heat exchangers. Calculation of the recuperator. 15. Cooling of technological water. Refrigeration plants.

Compulsory literature

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

D. Golubović	Transportni procesi (skripta predavanja u pripremi), ETF Istočno Sarajevo	2016	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
D. Golubović	Termodinamika, MF Istočno Sarajevo	2001	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	attendance at lectures/exercises	10	10 %
	midterm exams	25+25	25 %+25 %
	final exam (written/oral)	40	40 %
	TOTAL	100	100 %
Web page			
Certification date			

<table>
<tr><td></td><td colspan="2">UNIVERSITY OF EAST SARAJEVO
Faculty of Electrical Engineering</td><td></td></tr>
<tr><td></td><td colspan="2">Study program: Automation and Electronics</td><td></td></tr>
<tr><td></td><td>First study cycle</td><td>Third year of study</td><td></td></tr>
<tr><td>Full name of the course</td><td colspan="3">MATERIAL PHYSICS</td></tr>
</table>

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-154-5	compulsory	V	4,5

Teacher(s)	Željko Pržulj, PhD, full professor
Associate(s)	Željko Pržulj, PhD, full 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	37.5	37.5	0	1.25

total teaching workload (in hours, per semester)	total student workload (in hours, per semester)
W=2*15+2*15+0*15=60	$T=2*15*S_o+2*15*S_o+0*15*S_o=75$

Total workload of the subject (teaching + student): In_{opt}= W + T = 60+75 = 135 hours per semester

Learning outcomes	1. Knowledge of the physical basics, characteristics and structure of electrotechnical materials (semiconductors, conductors, superconductors, dielectrics, magnetics, ...); 2. Knowledge of the application of materials in various electrotechnical devices; 3. Ability to apply acquired knowledge of materials science in practical work; 4. Ability to follow, understand and apply the latest achievements in the field of new materials.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge from the subject: Physics, Physical fundamentals of electronics.
Teaching methods	Teaching is conducted in the form of lectures, auditory exercises and demonstration exercises on the computer. Learning, tests, assignments, term papers and consultations.
Subject content per weeks	1. Structure of crystalline bodies. Elementary cell. Dense packing. Reciprocal grid. Briullen zones. 2. Diffraction on crystals. Real crystals. Types of interactions in solids. 3. Model of free electron gas. Density of electronic states. Cavities. Effective mass. 4. Electrical conductivity of metals. Division and characteristics of conductive materials. Application. 5. Thermal properties of solids. Normal vibrations of the lattice. Phonons. 6. Heat capacity of solid bodies and electronic gas. Thermal conductivity. Wiedeman - French law. 7. Elements of the solid body zonal theory. Bloch's theorem. 8. Own semiconductors. Impurity semiconductors. 9. Diffusion, generation and recombination, continuity equation. 10. Comparative characteristics of the most important semiconductors. Application. 11. Dielectric polarization. Clausius-Mosoti relation. Theories of polarizability. Application. 12. Macroscopic characteristics of magnetic materials. Diamagnetism and paramagnetism. Electron gas paramagnetism. 13. Ferromagnetism and antiferromagnetism. The nature of magnetism. Exchange interaction. Domain walls. Application. 14. Phenomenological characteristics and theories of superconductors.

	15. Microscopic (BCS) theory of superconductivity. Josephson junctions. Application.				
Compulsory literature					
Author(s)		**Publication title, publisher**		**Year**	**Pages (from-to)**
M. Napijalo		Fizika materijala, Univerzitet u Beogradu		1996	
Ž. Pržulj, Z. Ljuboje, Z. Ivić		Zbirka riješenih zadataka iz fizike čvrstog stanja, ETF UIS		2016	
Additional literature					
Author(s)		**Publication title, publisher**		**Year**	**Pages (from-to)**
D. Raković		Fizičke osnove i karakteristike elektrotehničkih materijala, Akademska misao		2000	
Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**			**Points**	**Percentage**
	Pre-examination obligations				
	attendance at lectures/exercises			10	10 %
	written exam			40	40 %
	final exam (oral)			50	50 %
	TOTAL			100	100 %
Web page					
Certification date					

UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering		
Study program: *Automation and Electronics*		
First study cycle	Third year of study	

Full name of the course	**DIGITAL CONTROL SYSTEMS**

Subject code	**Subject status**	**Semester**	**ECTS**
00-1-032-6	compulsory	VI	7

Teacher(s)	assistant professor Nataša Popović
Associate(s)	assistant professor Nataša Popović

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	2	1	60	40	20	1.33

total teaching workload (in hours, per semester)	total student workload (in hours, per semester)
W = 3*15 + 2*15 + 1*15 = 90 h	T = 3*15*1.33+ 2*15*1.33+ 1*15*1.33= 120

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

Learning outcomes	1. By mastering this course, the student will acquire basic theoretical knowledge of linear digital control systems. 2. The student will acquire basic practical knowledge of linear digital control systems. 3. The student will be able to check and verify the acquired knowledge by simulation on a digital computer. 4. The student will be able to apply the acquired knowledge in analyzing and designing a specific system with direct digital control.
Prerequisites	There are no requirements for registering and attending the lectures. Required prior knowledge of the following subjects: Mathematics - 1, Theory of Automatic Control - 1, Theory of Automatic Control - 2.
Teaching methods	Teaching is carried out in the form of lectures, auditory and laboratory exercises.
Subject content per weeks	1. The basic structure of the digital control system. Sampling process. Properties of the Laplace transform and frequency spectrum of the impulse-sampled signal. 2. Z-transform and inverse Z-transform: properties and limitations. 3. Signal reconstruction. Data-hold circuits. 4. Pulse transfer function of the discrete-time system. Algorithms for the structural realization of a pulse transfer function. 5. Digital processor structures. Frequency characteristics. 6. Modified Z-transform, bilinear transform. 7. State space concept in digital systems modeling. 8. Relation between the discrete-time state-space equation and the pulse transfer function matrix. 9. Time-delayed digital systems. 10. Controllability and observability. 11. Stability of digital control systems. Algebraic and graph-analytic stability criteria. 12. Choice of the sampling period in sampled-data control systems. 13. Transient-state response analysis – root-locus method. 14. Steady-state response analysis.

	15. Practical examples: digital speed and position control systems.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
K. Ogata	Discrete-time control systems, 2nd edition, Prentice-Hall International, Inc.	1995	
R.C. Dorf, R.H. Bishop	Modern Control Systems, 13th edition, Pearson	2017	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
M. R. Stojić	Digitalni sistemi upravljanja, Akademska misao, Beograd	2001	
M. B. Naumović	Zbirka rešenih zadataka iz digitalnih sistema upravljanja, I deo: Diskretni signali, Elektronski fakultet, Niš	1997	

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	test/colloquium	45	45%
	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: *Automation and Electronics*	
	First study cycle | Third year of study	
Full name of the course	**DIGITAL ELECTRONICS**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-033-6	compulsory	VI	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 = 75+105 = 180 hours per semester

Learning outcomes	Upon successful completion of the course the students will be able to: 1. Understand operation of the combinational logic circuits and design complex combinational circuits, 2. Understand operation of the sequential logic circuits and design complex sequential circuits, 3. Understand operation and correct uses of memory circuits, 4. Understand operation and correct uses of A/D and D/A convertors, 5. 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: Logic gates*** **1.1** Real logic circuits. **1.2** Positive and negative logic. Expended symbols and operation interpretation of logic circuits. ***Module: Combinational circuits*** **2.1** Definition and design of the combinational circuits. **2.2.** Real combinational circuits. **3.** Decoders. **4** Coders. **5** Multiplexers. **6.** Demultiplexers. **7.** Arithmetic circuits (adder, binary comparators, multipliers). ***Module: Sequential circuits*** **8.1** Definition, basic types and design of the sequential circuits. **8.2** Latches and flip-flops. **9.** Latches and flip-flops. **10.** Registers. Buses. **11.** Counters. Types and design procedures.

	Module: Semiconductors memory **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: *Automation and Electronics*	
	First study cycle / Third year of study	

Full name of the course	**AUTOMATIC CONTROL THEORY - 2**

Subject code	Subject status	Semester	ECTS
AE-08-1-034-6	compulsory	VI	6

Teacher(s)	Marko Bošković, Assistant professor
Associate(s)	Marko Bošković, 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)	total student workload (in hours, per semester)
W=2*15 + 2*15 + 0*15 =60 hours	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	The course aims: 1. to teach students modern theory of linear time-invariant systems, closed-loop control systems. 2. to teach students analysis and synthesis of linear and nonlinear dynamical feedback systems. 3. to teach students methods for linearisation of nonlinear elements: static, harmonic and stochastic, as well as different stability criterions of nonlinear systems, basic nonlinear control laws etc. 4. with the acquired knowledge, to create a basis to study other control theory related courses.
Prerequisites	There are no prerequisites for enrolling the course. It is necessary to have prior knowledge of the following subjects: Mathematics - 1, Mathematics - 2, Mathematics - 3, Physics and Electric Circuits Theory, Automatic Control Theory – 1.
Teaching methods	Teaching is conducted in the form of lectures, auditory and demonstration exercises on the computer. The colloquium and the written part of the exam are taken in written form, while the oral part of the exam is taken orally. The final grade of the exam will be based on the success of the colloquium, the written part and the oral part of the exam. The Moodle platform is used for creating the content of teaching units, storing teaching materials and results of pre-examination obligations and final examinations, as well as for communication with students.
Subject content per weeks	1. Introduction to modern theory of control systems. State space representation. 2. Transformations of mathematical models from the state space to the complex domain. 3. Determining the response of the system in the state space. Fundamental matrix. 4. Transformation of the models in the state space. 5. State space and properties of the system. Controllability. Observability. Stabilizability 6. System stability in state space. Definition of stability according to Lyapunov. 7. System synthesis in state space. State and output feedback. 8. Kalman regulator. Observer. Principle of motion separation. Non-interactive systems.

	9. Introduction to nonlinear control systems. Typical nonlinearities and their characteristics. Linearization methods. 10. Phase space method. Properties, equations and construction methods of phase trajectories. 11. Harmonic linearization method. Describing function. 12. Stability of nonlinear control systems. The first and second methods of Lyapunov. Azerman and Kalman hypotheses. 13. Lurie's problem. Popov's frequency method. 14. Tsypkin's parabolic criterion. Stability of forced nonlinear processes. Examples. 15. On-off controllers. Variable structure systems, sliding modes.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
K. Ogata	Modern control engineering, Fifth edition, Prentice Hall	2010.	
J.J.E. Slotine, W. Li	Applied nonlinear control (Vol. 199, No. 1, p. 705). Englewood Cliffs, NJ: Prentice hall.	1991.	
H. K. Khalil	Nonlinear Control, Global Edition, Pearson Education Limited 2015	2015.	

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	25	25%
	midterm exam II	25	25%
	final exam (written/oral)	45	45%
	TOTAL	100	100%
Web page			
Certification date			

FOURTH YEAR – COMPULSORY SUBJECTS

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	First study cycle | Fourth year of study	
Full name of the course	**FUNDAMENTALS OF TELECOMMUNICATIONS**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-041-7	compulsory	VII	5,0

Teacher(s)	Mirjana Maksimović, PhD, Associate Professor
Associate(s)	Marko Bošković, 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	1	1	45	22.5	22.5	1.5

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

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	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: *Automation and Electronics*	
	First study cycle / Fourth year of study	

Full name of the course	**OPTIMAL SOLUTIONS THEORY**

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-141-7	compulsory	VII	5

Teacher(s)	assistant professor Nataša Popović
Associate(s)	assistant professor Nataša Popović

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**
2	2		2*15*1,5=45	2*15*1,5=45		1.5

total teaching workload (in hours, per semester)	total student workload (in hours, per semester)
W = 2*15 + 2*15 + 0*15 = 60 h	T = 2*15*1.5+ 2*15*1.5 = 90 h

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

Learning outcomes	1. By mastering this course, the student will acquire basic theoretical knowledge of different optimization methods. 2. The student will acquire basic theoretical knowledge necessary for finding the optimal solution to the concrete problem. 3. The student will be able to check and verify the acquired knowledge by simulation on a digital computer. 4. The student will be able to apply the acquired knowledge in solving problems from different fields.
Prerequisites	There are no requirements for registering and attending the lectures. Required prior knowledge of the following subjects: Mathematics-1, Mathematics-2, Automatic Control Theory -2.
Teaching methods	Teaching is carried out in the form of lectures and auditory exercises, face-to-face, group or individual teaching, with the hybrid use of the digital learning platform Moodle (LMS Moodle) in accordance with the developed methodology for hybrid learning. As part of the auditory exercises, students will have access to virtual laboratories set up on the Moodle digital platform. LMS Moodle will be used to create content and store course materials, communicate with students, and access practice tests to self-evaluate students' knowledge.
Subject content per weeks	1. Introduction to optimal control systems. 2. Basic terms, optimal control problem statement, optimality criteria. 3. Conditions for optimality. 4. Static optimization. 5. Optimization without constraints and with equality constraints. 6. Lagrange multipliers and Hamiltonian. 7. Linear programming. Linear programming problem statement. Simplex algorithm. Practical application of duality problem theory.

	8. Classical approaches to the design of continuous-time and discrete-time optimal control systems. 9. Calculus of variations. Optimization problem with specified final time. 10. Optimization problem with unspecified final time. 11. Optimization problem with constraints. 12. Maximum principle for continuous-time and discrete-time control systems. Optimality principle. 13. Dynamic programming. 14. Continuous-time linear quadratic regulator. Riccati equation. Separation principle. 15. Observers. Design examples.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
F. L. Lewis, D. L. Vrabie, V. L. Syrmos	Optimal Control, 3rd edition, John Wiley & Sons, Inc.	2012	
S. S. Rao	Engineering Optimization - Theory and Practice, 4th edition John Wiley & Sons, Inc.	2009	
A. Antoniou, W. S. Lu	Practical Optimization – Algorithms and Engineering Applications, Springer Science+Business Media, LLC	2007	
D. A. Piere	Optimization Theory with Applications, Dover Publication, Inc.	1986	
P. Sage, C. C. White	Optimum Systems Control, 2nd edition, Prentice-Hall, Inc.	1977	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
M. B. Naumović	„Tehnike optimalnog upravljanja“, WUS-Austria, EF Niš	2007	
N. Popović	PPT presentations of lectures and auditory exercises stored on the Moodle digital platform.	2022	

	Type of student work evaluation	Points	Percentage
Obligations, forms of knowledge assessment and grading	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	test/colloquium	45	45%
	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: *Automation and Electronics*	
	First study cycle / Fourth year of study	
Full name of the course	**MICROPROCESSOR SYSTEMS**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-043-7	compulsory	VII	5,0

Teacher(s)	PhD Slobodan Lubura, full professor
Associate(s)	Nikola Kukrić, BSCEE

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	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%
	final exam (written/oral)	50	50%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering		
	Study program: *Automation and Electronics*		
	First study cycle	Fourth year of study	

Full name of the course	**PROCESS MODELLING AND SIMULATION**

Subject code	Subject status	Semester	ECTS
AE-08-1-107-7	compulsory	VII	6

Teacher(s)	Marko Bošković, Assistant professor
Associate(s)	Marko Bošković, 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	1	2	42	21	42	1.4

total teaching workload (in hours, per semester)	total student workload (in hours, per semester)
W=2*15 + 1*15 + 2*15 =75 hours	$T= 2*15*S_o + 0*15*S_o + 3*15*S_o$ = 105 hours

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

Learning outcomes	The course aims: 1. to teach students various methods of mathematical process analysis in engineering practice. 2. to teach students to perform the synthesis of mathematical process models. 3. to teach students to use software tools MATLAB, SIMULINK and MAPLE, for implementation of developed mathematical models. 4. teach students to perform the exploitation of the results obtained from the model in engineering practice.
Prerequisites	There are no prerequisites for enrolling the course. It is necessary to have prior knowledge of the following subjects: Theory of Automatic Control – 1, Theory of Automatic Control – 2, Mathematics 1, 2 and 3, Physics
Teaching methods	Teaching is conducted in the form of lectures, auditory and demonstration exercises on the computer using software tools MATLAB, SIMULINK and MAPLE. Learning, tests, assignments and consultations.
Subject content per weeks	1. Introduction to the theory of modelling physical systems. Basic terms and definitions. 2. Introduction to the variational principle. Variational principles for statics and dynamics. 3. Modelling of mechanical systems represented by idealized elements. 4. Generalized coordinates. Hamilton's principle. Lagrange-Euler equations. 5. Derivation of dynamic equations of mechanical systems composed of rigid bodies. 6. Dynamic models of electromagnetic systems. Electromechanical analogies. 7. Modelling of hydraulic systems. 8. Program packages for simulation of dynamic systems: MATLAB, SIMULINK, MAPLE. 9. Formation and analysis of models in MATLAB, SIMULINK and MAPLE. SIMULINK Libraries. 10. Dynamic models of electromechanical systems. 11. Dynamics of incremental converters. Linearization of differential equations of motion. 12. Generalized rotary machine. Equations of motion of a generalized machine. 13. Dynamic models of commutator machines.

	14. Dynamic models of induction machines. Dynamics of a two-phase asynchronous machine. 15. Model of two-phase servo motor. Dynamics of a three-phase asynchronous machine. Models of synchronous machines.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
B. Fabien	Analytical System Dynamics: Modeling and Simulation. Springer Science & Business Media	2008.	
K.J. Åström, R.M. Murray	Feedback systems, An Introduction for Scientists and Engineers, 2^{nd} edition (Version v3.1.5 (2020-07-24))	2015.	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
H. Klee, R. Allen	Simulation of Dynamic Systems with MATLAB® and Simulink®, CRC Press	2011.	
J.M. Borwein, M.P. Skerritt	An Introduction to Modern Mathematical Computing: With MapleTM. Springer Science & Business Media	2011.	
D. Xue, Y. Chen	Scientific Computing with MATLAB®. Chapman and Hall/CRC	2018.	

	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	25	25%
	midterm exam II	25	25%
	final exam (written/oral)	45	45%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	First study cycle / Fourth year of study	

Full name of the course	**AUTOMATIC CONTROL SYSTEMS DESIGN**

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-051-8	compulsory	VIII	6

Teacher(s)	Tomislav Šekara, Full professor
Associate(s)	Marko Bošković, 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	3	42	0	63	1.4

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

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

Learning outcomes	The course aims: 1. to teach students various methods of process identification. 2.to teach students various methods for designing control systems. 3. to teach students to use software tools MATLAB, SIMULINK and MAPLE, for identification of processes and designing control systems. 4. with the acquired knowledge, to create a basis to study other control theory related courses.
Prerequisites	There are no prerequisites for enrolling the course. It is necessary to have prior knowledge of the following subjects: Theory of Automatic Control - 1, Theory of Automatic Control - 2
Teaching methods	Teaching is conducted in the form of lectures, auditory and demonstration exercises on the computer using software tools MATLAB, SIMULINK and MAPLE. Learning, tests, assignments and consultations.
Subject content per weeks	1. Introductory considerations: Structures and models of control systems, transfer function, state-space equations. 2. Characteristics of control systems in time and frequency domain. Time and frequency response. 3. Identification of processes. Model selection and parameterization. 4. Relay experiment and phase-locked loop. Methods for process model reduction. Identification by physical modeling. 5. Design of single-input single-output (SISO) control systems. 6. System performance and robustness. Procedures for controller design. Modern controller design methods with respect to sensitivity and complementary sensitivity functions. 7. Control algorithms and their implementation. Discrete control laws. 8. Design of complex control systems. Control with disturbance compensation. Cascade control. 9. Control of processes with transport delay. Smith predictor. 10. Design of multi-input multi-output (MIMO) control systems. 11. Pole positioning.

	12. Control system without complete information about state variables. State observer and disturbance observer. 13. Designing control systems for typical industrial processes. 14. Control systems based on fuzzy logic. Fuzzy sets. Expert systems. 15. Designing of sequential control systems. Ladder diagrams. PLC.			
Compulsory literature				
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**	
G.C. Goodwin, S.F. Graebe, M.E. Salgado	Control System Design, Prentice Hall	2000.		
K.J. Åström, R.M. Murray	Feedback systems, An Introduction for Scientists and Engineers, 2nd edition (Version v3.1.5 (2020-07-24))	2015.		
Bosgra, O. H., Kwakernaak, H., & Meinsma, G. (2001).	Design methods for control systems. Notes for a course of the Dutch Institute of Systems and Control Winter term 2007–2008	2008.		
Additional literature				
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**	
K.J. Åström, T. Hägglund	PID Controllers: Theory, Design, and Tuning, ISA	1995.		
K.J. Åström, T. Hägglund	Advanced PID control (Vol. 461). Research Triangle Park: ISA-The Instrumentation, Systems, and Automation Society	2006.		
J.E. Normey-Rico, E.F. Camacho	Control of dead-time processes, Springer	2007.		
В.Я. Ротач	Теория автоматического управления, Издательство МЭИ, Москва	2008.		
A. O'Dwyer,	Handbook of PI and PID Controller Tuning Rules, Imperial College Press (3rd Edition),	2009.		
S. Skogestad, I. Postlethwaite	Multivariable feedback control: analysis and design. John Wiley & sons.	2005.		
D. Xue, Y. Chen	System simulation techniques with MATLAB and Simulink. John Wiley & Sons	2013.		

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	midterm exam I	25	25%
	midterm exam II	25	25%
	final exam (written/oral)	45	45%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	First study cycle | Fourth year of study	
Full name of the course	**COMPUTER PROCESS CONTROL**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-1-052-8	compulsory	VIII	6,0

Teacher(s)	PhD Slobodan Lubura, full professor
Associate(s)	Zorana Mandić, BSCEE

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

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

Learning outcomes	Upon completion of the course the student will be able: 1. Describe various types of PLC and their application in automation systems, 2. Identify the inputs and outputs of a PLC in various applications, 3. Use counters, timers, algebraic and boolean operations, memory, subroutines etc. of PLC to do a certain task, 4. Write and test PLC Programs for small industrial automation applications,
Prerequisites	Digital electronics, Introduction to programming in C
Teaching methods	• Interactive lectures and communication with students • Discussion and Group Works • Presentation • Homework • Project
Subject content per weeks	1. PLC evolution, history, relay control, basic parts of PLC, ladder logic language, 2. PLC hardware, connection paths, CPU, memory, digital and analog interfaces (IO), 3. Addressing of IO, program cycle, scan time, 4. Relay schematics to ladder logic, field devices, IO modules, 5. PLC Programming and bit logic instructions, 6. PLC timer functions, typical industrial timing tasks, 7. PLC counters in ladder logic, typical industrial tasks, 8. Basic PLC math and logic functions, 9. Compare, Jump & MCR Instructions, 10. Subroutine Functions, typical industrial tasks, 11. Transferring data, operations with math functions, data manipulation, 12. Examples of processes with math/data operations on a fast and continuous basis, 13. PLC sequencer and shift register functions in control problems, 14. Troubleshooting & Servicing, 15. PLC Networks in Manufacturing.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Frank Petruzella	Programmable logic controllers, 4th edition McGraw Hill	2013	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
John W. Webb, Ronald A. Reis,	Programmable Logic Controllers: Principles and Applications (5th Edition)	2003	

	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	50	50%
	final exam (written/oral)	35	35%
	TOTAL	100	100%
Web page			
Certification date			

THIRD YEAR – ELECTIVE SUBJECTS

<table>
<tr><td rowspan="4"></td><td colspan="2">UNIVERSITY OF EAST SARAJEVO
Faculty of Electrical Engineering</td><td rowspan="4"></td></tr>
<tr><td colspan="2">Study program: Automation and Electronics</td></tr>
<tr><td>First study cycle</td><td>Third year of study</td></tr>
</table>

<table>
<tr><td>Full name of the course</td><td colspan="6">POWER ELECTRONICS CONVERTERS CONTROL - 2</td></tr>
<tr><td colspan="2">Subject code</td><td colspan="2">Subject status</td><td colspan="2">Semester</td><td>ECTS</td></tr>
<tr><td colspan="2">AE-08-2-178-6</td><td colspan="2">elective</td><td colspan="2">VI</td><td>5</td></tr>
<tr><td>Teacher(s)</td><td colspan="6">Prof. dr Milomir Šoja, full professor</td></tr>
<tr><td>Associate(s)</td><td colspan="6">Zorana Mandić, teaching assistant</td></tr>
<tr><td colspan="3">Number of lessons/teaching workload (weekly)</td><td colspan="3">Individual student workload (in hours per a semester)</td><td>Student workload coefficient S_o</td></tr>
<tr><td>L</td><td>AE</td><td>LE</td><td>L</td><td>AE</td><td>LE</td><td>S_o</td></tr>
<tr><td>2</td><td>0</td><td>2</td><td>45</td><td>0</td><td>45</td><td>1.5</td></tr>
<tr><td colspan="3">total teaching workload (in hours, per semester)
W=2*15+0*15+2*15=60 h</td><td colspan="4">total student workload (in hours, per semester)
$T=2*15*S_o+0*15*S_o+2*15*S_o=90$ h</td></tr>
<tr><td colspan="7">Total workload of the subject (teaching + student): In_{opt}= W + T = 60+90 = 150 hours per semester</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon successful completion of the course the students will be able to:
1. Understand the importance of proper control of power electronics converters,
2. Select circuitss for optimal triggering/driving and protection of semiconductor switches,
3. Design circuits for measuring the characteristic values of converters,
4. Design circuits for phase-control of AC-AC and AC-DC converters,
5. Design circuits for voltage/current control of DC-DC converters,
6. Understend the control principles of DC-AC converters,
7. Understand the principles of digital control of power electonics converters,
8. Use specialized software for designing the control of power electronics converters.</td></tr>
<tr><td>Prerequisites</td><td colspan="6">Prerequisites require knowledge of power electronics, digital electronics and automation (course: Control of Power Electronics Converters I, Digital electronics, Impulse electronics, Theory of automatic control I), while passing the exam requires ≥50% points in each forms of knowledge assessment.</td></tr>
<tr><td>Teaching methods</td><td colspan="6">Lectures, auditory practical lectures, labs.</td></tr>
<tr><td>Subject content per weeks</td><td colspan="6">Modul: Introduction
1. Student obligations and assessments. Overview of power converter application. The importance of control mechanism.
Modul: Semiconductor switches
2. Triggering/driving and protection of thyristors, MOSFET and IGBT.
3. Modular and integrated switches.
Modul: Measurement of characteristic converter values
4. Measurement of: voltage, current, efficiency, temperature, size ratio in power converters.
Modul: Phase control
5. The principle of phase control. Synchronization for different types of converters.
6. TSA785. Examples of use for different types of converters.
7. Digital realization of phase control.
Modul: PWM
8. Block structure of PWM. Formation of bipolar and unipolar voltage output.</td></tr>
</table>

	Modul: Control of DC-DC converters **9.** Voltage control. 3525 integrated circuit. **10.** Current control. 3842 integrated circuit. **11.** Parallel operation and multiphase control. ***Modul: Control of inverters*** **12.** Sinus PWM. Space vector control. ***Modul: Digital control of power converters*** **13.** The principle of digital control of power converters. **14.** Digital control of power converters from MATLAB. ***Modul: Specialized software for control design of power converters*** **15.** Specialized software for control design of power converters.

Compulsory literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Erickson, R. W., Maksimović, D.	*Fundamental of Power Electronics*, Springer Science+Business Media, LCC	2001.	
Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Luo, F.L., Ye, H., Rashid, M.	*Digital Power Electronics and Applications*, Elsevier Academic Press	2005.	
S. Buso, P. Mattavelli	*Digital Control in Power Electronics*, Morgan & Claypool Publishers	2006.	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	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: *Automation and Electronics*	
	First study cycle / Third year of study	

Full name of the course	**ELECTRONIC MEASUREMENTS**

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-2-037-6	elective	VI	5

Teacher(s)	Srđan Lale, PhD, assistant 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	1	1	45	22.5	22.5	1.5

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

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

Learning outcomes	Upon successful completion of the course the students will be able to: 1. Describe basic terms from measurement of electronic quantities. 2. Understand the operating principles of electronic generator. 3. Select methods for measurement of frequency, time, period, etc. 4. Use knowledge and skills from this course in practical realizations.
Prerequisites	There are no requirements for registering and listening to the course.
Teaching methods	Lectures, auditory and laboratory exercises.
Subject content per weeks	1. Principles of operation, signal conditioning. 2. Amplifiers, converters, standard signals. 3. Digital measurement instruments. 4. Electronic measurement of voltage and current. 5. Electronic generators. 6. Timers. 7. Counters. 8. Frequency measurement. 9. Time period measurement. 10. Phase difference measurement. 11. Pulse width measurement. 12. D/A converters with weight resistive network. 13. D/A converters with R-2R network. 14. A/D converters. 15. Voltage to frequency converters.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
F. Asadi, Kei Eguchi	Electronic measurements: A practical approach, Morgan & Claypool	2021	
K. Lal Kishore	Electronic measurements and instrumentation, Pearson Education	2010	

Additional literature

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

J. J. Carr	Elements of electronic instrumentation and measurement, Prentice Hall	1996	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	attendance at lectures/exercises	5	5 %
	lab. exercises/practical work	15	15 %
	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: *Automation and Electronics*	
	First study cycle | Third year of study	
Full name of the course	**DIGITAL SIGNAL PROCESSING**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-2-039-6	elective	VI	5

Teacher(s)	Mirjana Maksimović, PhD, Associate Professor
Associate(s)	Mirjana Maksimović, PhD, Associate 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)	total student workload (in hours, per semester)
W=2*15+2*15+0*15=60 h	$T=2*15*S_o+2*15*S_o+0*15*S_o=90$ 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: 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: Electric Circuits Theory 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, Prentice Hall	1996.	
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 %
	midterm exam I	20	20 %
	midterm exam II	20	20 %
	final exam (written/oral)	45	45 %
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering ***Study program:*** *Automation and Electronics* First study cycle / Third year of study	
Full name of the course	**INTRODUCTION TO NANOSCIENCES AND NANOTECHNOLOGIES**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-2-147-6	elective	VI	5

Teacher(s)	Željko Pržulj, PhD, full professor
Associate(s)	Željko Pržulj, PhD, full 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. Understanding the basic trends and significance of the ongoing nanotechnological revolution; 2. Acquaintance with the latest research and perspectives in the field of nanoelectronics; 3. Connecting previously acquired knowledge with the current development of nanotechnologies; 4. Ability for independent professional work: selection and analysis of professional and scientific literature related to a certain aspect of nanotechnology research, as well as their presentation.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge in the subjects: Physics, Physical fundamentals of electronics, Materials physics and Electronics 1.
Teaching methods	Teaching is conducted in the form of lectures, auditory exercises and demonstration exercises on the computer. Learning, tests, assignments, term papers and consultations.
Subject content per weeks	1. Basic concepts; research directions, application, perspectives; Moore's Law; The third NTR. 2. Nanostructure manufacturing technologies: metal-organic epitaxy, molecular beam epitaxy. 3. Lithography; electronic lithography; nanoprinting, Dip-pen nanolithography. 4. Deposition methods; oxidation; electrodeposition; methods using scanning probes. Physical basics and working principle of AFM and STM. Processes of self-organization. 5. Methods of characterization of nanostructures: microscopic, diffraction and spectroscopic. 6. Semiconductor heterostructures, density of states in elementary nanostructures. 7. Transport properties of nanostructures (tunneling transport, current and conductivity in 1d systems). 8. Transport properties of nanostructures (resonant tunneling, Coulomb blockade, one-electron tunneling). 9. Phase interference of electronic waves, Aharonov-Bohm effect, quantum Hall effect. 10. Application of semiconductor nanostructures (semiconductor lasers with quantum wells, quantum cascade lasers, devices with resonant tunneling, single-electron devices,...). 11. Spintronics: Superparamagnetism; Magnetoresistance (giant, normal, tunnel,...).

	12. Spintronics: spin valves, MRAM, spin transistors, spin logic circuits. 13. Allotropic modifications of carbon; Fullerenes: properties, synthesis and application. 14. Carbon nanotubes: types, structure, electronic structure, physical properties, application. 15. Graphene: electronic properties, anomalous quantum Hall effect, chiral tunneling, application.

Compulsory literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
Ž. Pržulj	Uvod u nanonauke i nanotehnologije, ETF I. Sarajevo	2013	
C. P. Poole, F. J. Owens	Introduction to Nanotechnology, John Wiley & Sons	2003	

Additional literature

Author(s)	Publication title, publisher	Year	Pages (from-to)
J. H. Davies	The Physics of Low-Dimensional Semiconductors, Cambridge University Press	1998.	

	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	25	25 %
	tests	40	40 %
	final exam (written/oral)	25	25 %
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	First study cycle | Third year of study	
Full name of the course	**SIGNALS AND SYSTEMS ANALYSIS**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-2-040-6	elective	VI	5

Teacher(s)	Mirjana Maksimović, PhD, Associate Professor
Associate(s)	Mirjana Maksimović, PhD, Associate 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)	total student workload (in hours, per semester)
W=2*15+2*15+0*15=60 h	$T=2*15*S_o+2*15*S_o+0*15*S_o=90$ 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: 1. gain the basic theoretical and practical knowledge of continuous signals and systems analysis in the time and frequency domain. 2. understand the most general description of systems, their classification and qualitative properties, 3. gain insight into the overview of algorithms for the analysis of linear time-invariant (LTI) systems in the time and complex domains, 4. get acquainted with the concept of analog filtering.
Prerequisites	There are no prerequisites for enrolling the course. It is necessary to have prior knowledge of the following subjects: Electric Circuits Theory I and II, Mathematics, I, II and III.
Teaching methods	Teaching is conducted in the form of lectures, auditory and demonstration exercises. Learning, tests and consultations.
Subject content per weeks	1. Systems models and their classification. Basics of signals. 2. Periodic signals. Decomposition of periodic signals. 3. Aperiodic signals. Decomposition of aperiodic signals. 4. Signal representation. Amplitude modulation. 5. Types of amplitude modulations and their demodulation. Angle modulation. Phase modulation. 6. Impulse modulation. 7. Pulse code modulation (PCM). Multi-channel information transmission systems. 8. Continuous time linear systems. Convolution integral. 9. Frequency response method. Fourier transforms. 10. Application of the Laplace transformation. 11. Linear systems: block diagram representation. 12. Normal equations: a matrix approach. 13. Non-stationary response determination 14. Discrete time linear systems. 15. Time domain analysis. Weight sequence. State equations.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
M. Maksimović	Lecture presentations		

M. D. Adams	Signals and Systems, 3rd edition, University of Victoria, British Columbia, Canada	2020.	
B. Boulet	Fundamentals of Signals and Systems, Charles River Media	2006.	
A. D. Poularikas	Signals and Systems Primer with MATLAB, CRC Press	2007.	
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 %
	midterm exam I	20	20 %
	midterm exam II	20	20 %
	final exam (written/oral)	45	45 %
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	First study cycle | Third year of study	

Full name of the course	**ELECTRIC MACHINES AND PLANTS**

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-2-091-6	elective	VI	5

Teacher(s)	Petar Matić, PhD, full professor
Associate(s)	Srđan Jokić, 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)	total student workload (in hours, per semester)
W=2*15+2*15+0*15=60 h	$T=2*15*S_o+2*15*S_o+0*15*S_o=90$ h

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

Learning outcomes	1. Getting to know the working principles of transformers and rotary electrical machines 2. Ability to determine the parameters and characteristics of electrical machines 3. Getting to know the principles of regulation and starting of electrical machines 4. Getting to know the operation of electrical machines in the power system 5. Getting to know the basic elements of power plants.
Prerequisites	There are no requirements for registering and listening to the course. Required prior knowledge from the subjects: Fundamentals of electrical engineering 1 and 2, Electric circuits theory 1 and 2 and Electromagnetics-1.
Teaching methods	lectures, auditory exercises, laboratory exercises, seminar work, field teaching
Subject content per weeks	1. Transformers: Kapp's diagram, 2. Autotransformer, Three-phase transformation, 3. Heating and cooling, Laws of similarity, 4. Asynchronous machines, Phase voltage, Rotating field, Torque in the slip function M=f(x), 5. Starting, regulation n(0/min), Single-phase motor, 6. Switching machines for unidirectional. current, rotation voltage E and torque M, Inductance reaction, 7. Auxiliary poles, Compensation, Generators and motors, Reg. n(0/min) voltage and field, 8. Synchronous machines, Inductance reaction, Synchronous reactances Xd and Xq, 9. Phasor diagram, Synchronization, Regulation of Q(var) and P(w), Oscillations, 10. Generalized theory of electrical machines, Matrix equation of the fundamental machine, 11. Transformation of "A,B and C" into "a,b" and "d-q", 12. Examples for j.c.c machine, synchronous and asynchronous machine, 13. Plants, switches, disconnectors, 14. Measuring transformers, 15. Armored (cellular) plants. Large plants for outdoor assembly.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
S. N. Vukosavić	Electrical Machines, 2013th Edition, Springer	2012	

I. Boldea, L. N. Tutelea	Electric Machines: Steady State, Transients, and Design with MATLAB®, 1st Edition, CRC Press	2009	
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	10	10 %
	test/midterm exam	30	30 %
	lab. exercises	10	10 %
	final exam (written/oral)	50	50 %
	TOTAL	100	100 %
Web page			
Certification date			

FOURTH YEAR – ELECTIVE SUBJECTS

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	First study cycle / Fourth year of study	
Full name of the course	**DATA TRANSMISSION AND ACQUISITION**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-2-046-7	elective	VII, VIII	5

Teacher(s)	Mirjana Maksimović, PhD, Associate Professor
Associate(s)	Nataša Popović, 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)	total student workload (in hours, per semester)
W=2*15+2*15+0*15=60 h	$T=2*15*S_o+2*15*S_o+0*15*S_o=90$ 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: 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, I2C, 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.

<table>
<tr><td></td><td colspan="4">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.</td></tr>
<tr><td colspan="5">Compulsory literature</td></tr>
<tr><td colspan="2">Author(s)</td><td>Publication title, publisher</td><td>Year</td><td>Pages (from-to)</td></tr>
<tr><td colspan="2">M. Maksimović</td><td>Lecture presentations</td><td></td><td></td></tr>
<tr><td colspan="2">A. S. Tanenbaum, D. J. Wetherall</td><td>Computer Networks,
Prentice Hall</td><td>2011.</td><td></td></tr>
<tr><td colspan="5">Additional literature</td></tr>
<tr><td colspan="2">Author(s)</td><td>Publication title, publisher</td><td>Year</td><td>Pages (from-to)</td></tr>
<tr><td colspan="2">R. G. Gallager</td><td>Fundamentals of Telecommunications,
Wiley</td><td>1999.</td><td></td></tr>
<tr><td rowspan="8">Obligations, forms of knowledge assessment and grading</td><td colspan="2">Type of student work evaluation</td><td>Points</td><td>Percentage</td></tr>
<tr><td colspan="4">Pre-examination obligations</td></tr>
<tr><td colspan="2">attendance at lectures/exercises</td><td>5</td><td>5 %</td></tr>
<tr><td colspan="2">midterm exam I</td><td>22.5</td><td>22.5 %</td></tr>
<tr><td colspan="2">midterm exam II</td><td>22.5</td><td>22.5 %</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="2">final exam (written/oral)</td><td>50</td><td>50 %</td></tr>
<tr><td colspan="2">TOTAL</td><td>100</td><td>100 %</td></tr>
<tr><td>Web page</td><td colspan="4"></td></tr>
<tr><td>Certification date</td><td colspan="4"></td></tr>
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	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	First study cycle | Fourth year of study	
Full name of the course	**MANAGEMENT IN ENGINEERING PRACTICE**	

Subject code	Subject status	Semester	ECTS
AE-08-2-047-7	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)	total student workload (in hours, per semester)
W=2*15+2*15+0*15=60 h	$T=2*15*S_o+2*15*S_o+0*15*S_o=90$ 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.	

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	30	30 %
	final exam (written/oral)	60	60 %
	TOTAL	100	100 %
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	Firs study cycle | Fourth year of study	
Full name of the course	**SPECIAL SENSORS AND INDUSTRIAL MEASUREMENTS**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-2-048-7	elective	VII, VIII	5

Teacher(s)	PhD Božidar Popović, Associate Professor
Associate(s)	MSc Nikola Kukrić, 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	By mastering this subject, the student will be able to: 1. Understanding and developing the perception of measuring non-electric quantities using sensors, bearing in mind that the current or voltage output signal must be in the form of standard signals. 2. Understanding and differentiation of sensors, as well as the technique of measuring non-electric quantities 3. Understanding the principles of work and application 4. Understanding and application of binding schemes and adjustment of output sizes 5. Based on the set problem, carefully analyzing the environment, purpose and working conditions, choose the appropriate sensors in order to efficiently, safely and reliably receive the appropriate signals that describe the work process that is planned to be monitored or managed.
Prerequisites	Attended Electrical Measurements course
Teaching methods	Lectures, auditory exercises, laboratory exercises
Subject content per weeks	1. Principles of measurement. Introduction to measurement-metrology. Planning and organization of measurements. Processing of measurement results of direct, indirect and parametric measurements. 2. Presentation and registration of measurement results. Data registration, Reliability of measuring devices. 3. Basics of sensor technology, Technical characteristics of sensors. 4. Resistive sensors. 5. Electromagnetic and capacitive sensors. 6. Piezoelectric sensors. 7. Optoelectronic and digital sensors. 8. Sensors and methods of measuring non-electric quantities. 9. Linear and angular displacement sensors. 10. Speed and acceleration sensors, Force and torque sensors. 11. Pressure sensors, level sensors.

	12. Flow sensors, Temperature measurement. 13. Sensors and systems for measuring and controlling air quality. 14. Sensors and systems for measuring and controlling water quality. 15. Thermovision measurements and analysis of thermograms.			
Compulsory literature				
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**	
J. Fraden	Handbook of Modern Sensors, Springer	2010		
Additional literature				
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**	
J. P. Bentley	Principles of measurement systems, Pearson Education	2005		
B. Popović, T Šekara	Sensors and measurements -Collection of solved problems, ETF East Sarajevo	2019		
Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**	
	Pre-examination obligations			
	attendance at lectures/exercises	5	5%	
	midterm exam	30	30%	
	lab. exercises/practical work	10	10%	
	seminar paper	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: *Automation and Electronics*	
	Firs study cycle / Fourth year of study	
Full name of the course	**PROCESS IDENTIFICATION**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-2-092-7	elective	VII, VIII	5

Teacher(s)	Slobodan Lubura, PhD, full professor
Associate(s)	Nataša Popović, 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	By mastering this subject, the students will be able to: 1. Understand different process identification methods. 2. Derive the mathematical model of the process according to the identified parameters. 3. Use different software tools for identification and modelling of the industrial processes.
Prerequisites	Required prior knowledge from: Process modeling and simulation, Automatic control theory 1, 2, and Digital control systems.
Teaching methods	Lectures, auditory exercises, laboratory exercises, seminar papers and consultations.
Subject content per weeks	1. Introduction. Definition of identification. 2. Active process identification. Gradient method. Method of error equation. 3. Identification of static characteristics of the process. Regression analysis. 4. Identification of static characteristics by using polynomial approximation. 5. Identification by using sequential regression. 6. Identification by using stochastic approximation. 7. Method of sequential learning. 8. Identification by using response of the system. 9. Derivation of the mathematical model of the process in the form of transfer function according to the step response. 10. Enhanced variant of the Eiserman's method. 11. Identification of discrete processes. 12. Identification of the processes in the presence of stochastic signals. 13. Experimental determination of the correlation functions. 14. Evaluation of the identification quality. 15. Software tools for process identification.

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
L. Ljung	System Identification: Theory for the User, 2^{nd} Edition, Pearson	1998	

Additional literature			
Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Y. Zhu	Multivariable System Identification For Process Control, 1st Edition, Elsevier Science	2001	

Obligations, forms of knowledge assessment and grading	**Type of student work evaluation**	**Points**	**Percentage**
	Pre-examination obligations		
	attendance at lectures/exercises	5	5%
	test/midterm exam	40	40%
	lab. exercises/practical work	15	15%
	seminar paper	10	10%
	final exam (written/oral)	30	30%
	TOTAL	100	100%
Web page			
Certification date			

	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering	
	Study program: *Automation and Electronics*	
	Firs study cycle / Fourth year of study	
Full name of the course	**MICROPROCESSOR CONTROL OF ELECTRIC DRIVES**	

Subject code	**Subject status**	**Semester**	**ECTS**
AE-08-2-105-7	elective	VII, VIII	5

Teacher(s)	Branko Blanuša, PhD, full professor
Associate(s)	Goran Vuković, 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	By mastering this subject, the students will be able to: 1. Understand basic types of electric drives and their characteristics. 2. Understand the structure, peripherals and programming of the microprocessors for digital signal processing (DSP). 3. Understand basic methods for digital control of electric drives, pulse-width modulation (PWM), space-vector modulation (SVM) and their implementation on the DSP. 4. Implement linear speed and position control methods on the DSP.
Prerequisites	Required prior knowledge from: Electric machines and plants, Power electronics converters control 1 and 2, Digital control systems, and Microprocessor systems.
Teaching methods	Lectures, auditory exercises, laboratory exercises, seminar papers and consultations.
Subject content per weeks	1. Structure, peripherals and programming of modern DSPs. 2. Overview and basic characteristics of the electric drives with direct current motors. 3. Overview and basic characteristics of the electric drives with induction motors. 4. Overview and basic characteristics of the electric drives with synchronous motors. 5. Overview and application of basic topologies of power electronics converters for control of electric drives. 6. Application of DSPs for control of electric drives. 7. Programming of the DSPs in C language, examples. 8. PWM, SVM. 9. Digital control of current, torque and flux in direct current motors. 10. Digital control of current, torque and flux in induction motors. 11. Digital control of current, torque and flux in synchronous motors. 12. Scalar control of the induction motors. 13. Vector control of the induction motors. 14. Design of the digital speed and position controllers. 15. Practical realization.

Compulsory literature

<table>
<tr><th>Author(s)</th><th>Publication title, publisher</th><th>Year</th><th>Pages (from-to)</th></tr>
<tr><td>R. Koziol, J. Sawicki, L. Szklarski</td><td>Digital Control of Electric Drives (Studies in Electrical and Electronic Engineering Book 43), Elsevier Science</td><td>2013</td><td></td></tr>
<tr><th colspan="4">Additional literature</th></tr>
<tr><th>Author(s)</th><th>Publication title, publisher</th><th>Year</th><th>Pages (from-to)</th></tr>
<tr><td>W. Leonhard</td><td>Control of Electrical Drives, 3rd Edition, Springer</td><td>2001</td><td></td></tr>
</table>

<table>
<tr><th rowspan="8">Obligations, forms of knowledge assessment and grading</th><th>Type of student work evaluation</th><th>Points</th><th>Percentage</th></tr>
<tr><td colspan="3">Pre-examination obligations</td></tr>
<tr><td>attendance at lectures/exercises</td><td>5</td><td>5%</td></tr>
<tr><td>test/midterm exam</td><td>40</td><td>40%</td></tr>
<tr><td>lab. exercises/practical work</td><td>15</td><td>15%</td></tr>
<tr><td>seminar paper</td><td>10</td><td>10%</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>final exam (written/oral)</td><td>30</td><td>30%</td></tr>
<tr><td></td><td>TOTAL</td><td>100</td><td>100%</td></tr>
<tr><th>Web page</th><td colspan="3"></td></tr>
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	UNIVERSITY OF EAST SARAJEVO Faculty of Electrical Engineering		
	Study program: *Automation and Electronics*		
	First study cycle	Fourth year of study	
Full name of the course	**MODERN MECHATRONIC SYSTEMS**		

Subject code	Subject status	Semester	ECTS
AE-08-2-201-7	elective	eighth	5

Teacher(s)	PhD Slobodan Lubura, full professor
Associate(s)	Zorana Mandić, BSCEE

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

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

Learning outcomes	Upon completion of the course the student will be able: 1. Define mechatronics and its application to modern automated systems 2. Organize the operation and control of physical systems into tasks and states 3. Examine the use of sensors that monitor and control the operation of mechatronic systems 4. List the advantages of electrically powered actuators and select an appropriate actuator for a given mechatronic application 5. Examine measurement equipment used in the design, installation, and repair of mechatronic equipment. 6. Apply safety precautions associated with mechatronic systems.
Prerequisites	None
Teaching methods	• Interactive lectures and communication with students • Discussion and Group Works • Presentation • Homework • Project
Subject content per weeks	1. Description and history of mechatronics as a scientific discipline 2. Concept of computer process control 3. Components of computer process control system: sensors, actuators, HMI, communications 4. Introduction to FESTO flexible production stations 5. Programming robot station (Mitsubishi RV-2SDB) with teach pedant. 6. Programming robot station (Mitsubishi RV-2SDB) with CIROS robot studio 7. Programming FESTO MPS sorting station 8. Programming FESTO MPS processing station 9. Programming FESTO MPS handling station 10. Programming FESTO MPS testing station 11. Programming FESTO MPS distributing station

	12. Programming FESTO MPS-PA station – PID and hysteresis tank level control system 13. Programming FESTO MPS-PA station – PID and hysteresis tank heating control system 14. Programming FESTO MPS-PA station – PID and hysteresis tank flow control system 15. Programming FESTO MPS-PA station – PID and hysteresis tank pressure control system

Compulsory literature

Author(s)	**Publication title, publisher**	**Year**	**Pages (from-to)**
Robert H. Bishop	The Mechatronics Handbook	2002	all
MITSUBISHI ELECTRIC CORPORATION	CRnQ/CRnD Controller INSTRUCTION MANUAL Detailed explanations of functions and operations	2011	all
FESTO GmbH	CIROS Studio 1.0 User’s Guide	2008	all
FESTO GmbH	FESTO MPS sorting station Manual	2006	all
FESTO GmbH	FESTO MPS processing station Manual	2006	all
FESTO GmbH	FESTO MPS handling station Manual	2006	all
FESTO GmbH	FESTO MPS testing station MAnual	2006	all
FESTO GmbH	Festo Distributing station Manual	2006	all
FESTO GmbH	MPS PA Compact Workstation: Manual - Festo Didactic	2008	all

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	10	10%
	lab. exercises/practical work	50	50%
	final exam (written/oral)	35	35%
	TOTAL	100	100%

Web page	
Certification date	