

# Assessment and analysis of the position of HEIs, review of qualifications and analysis of the content of study programs in Bosnia and Herzegovina

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# Introduction

- In modern educational and industrial frameworks, energy sector and production of electricity within electrical engineering is increasingly intertwined with computing.
- Unfortunately, study programs dealing with this topic are relatively rare in Bosnia and Herzegovina, primarily due to the lack of appropriate laboratories at Universities.
- Consequently, only four universities in Bosnia and Herzegovina, all of them being state-owned, offer such programs, reflecting the specialized nature and limited accessibility of electrical engineering education in the region.

University of Sarajevo

# Faculty of Electrical Engineering

- **Basic academic studies 180 ECTS:** Electrical engineering
  - Specialization: Electrical engineering
  - Output: Bachelor of Electrical Engineering
  - <https://www.etf.unsa.ba/elektroenergetika-prvi-ciklus>
- **Master of Academic Studies 120 ECTS:** Electrical Engineering
  - Specialization: Electric Power Networks and Systems (EEMS)
  - Output: Master of electrical engineering
  - <https://www.etf.unsa.ba/elektroenergetika-drugi-ciklus>
- **Doctoral academic studies 180 ECTS:** Electrical engineering
  - Specialization: Electrical engineering
  - Output: Doctor of Technical Sciences in the field of electrical engineering
  - <https://www.etf.unsa.ba/elektroenergetika-treci-ciklus>

University of East Sarajevo

# Faculty of Electrical Engineering

- **Basic academic studies** 240 ECTS: Electrical engineering in Serbian
  - Output: Bachelor of Electrical Engineering (240 ECTS)
  - [https://www.etf.ues.rs.ba/studijski\\_program.php?task=view&stp\\_id=2](https://www.etf.ues.rs.ba/studijski_program.php?task=view&stp_id=2)
- **Basic academic studies** 240 ECTS: Electroenergetics in English
  - Output: Bachelor of Electrical Engineering (240 ECTS)
  - [https://www.etf.ues.rs.ba/eng/studijski\\_program.php?task=view&stp\\_id=2](https://www.etf.ues.rs.ba/eng/studijski_program.php?task=view&stp_id=2)
- **Master of Academic Studies** 60 ECTS: Electrical Engineering in Serbian
  - Output: Master of Electrical Engineering-Electroenergetics (300 ECTS)
  - [https://www.etf.ues.rs.ba/studijski\\_program.php?task=view&stp\\_id=7](https://www.etf.ues.rs.ba/studijski_program.php?task=view&stp_id=7)

University of East Sarajevo

# Faculty of Electrical Engineering

- **Master of academic studies** 60 ECTS: Electroenergetics in English
  - Output: Master of Electrical Engineering (300 ECTS)
  - [https://www.etf.ues.rs.ba/eng/studijski\\_program.php?task=view](https://www.etf.ues.rs.ba/eng/studijski_program.php?task=view)
- **Master of academic studies** 60 ECTS: Renewable energy sources and smart grids in Serbian
  - Output: Master of Electrical Engineering-Electroenergetics (300 ECTS)
  - [https://www.etf.ues.rs.ba/download/akti/etf/Elaborat OIE i pametne EE mreže.pdf](https://www.etf.ues.rs.ba/download/akti/etf/Elaborat_OIE_i_pametne_EE_mreze.pdf)

University of Tuzla

# Faculty of Electrical Engineering

- **Basic academic studies** 240 ECTS: Electrical engineering and computing
  - Specialization: Electric Power Networks and Systems (EEMS)
  - Output: Bachelor of Electrical Engineering
  - <https://www.fet.ba/ciklus-1>
- **Master of academic studies** 60 ECTS: Electrical engineering and computing
  - Specialization: Electric Power Networks and Systems (EEMS)
  - Output: Master of electrical engineering
  - <https://www.fet.ba/ciklus-2>
- **Doctoral academic studies** 180 ECTS: Electrical engineering and computing
  - Orientation is achieved through subject selection
  - Output: Doctor of Technical Sciences in the field of electrical engineering
  - <https://www.fet.ba/ciklus-3>

University of Banja Luka

# Faculty of Electrical Engineering

- **Basic academic studies** 240 ECTS: Electric power and automation engineering
  - Output: Bachelor of Electrical Engineering (240 ECTS)
  - <https://etf.unibl.org/studiranje/1-ciklus/osnovne-informacije/s-udi-s-i-pr-gr-l-r-n-rg-i-i-u-i/plan-elektroenergetika.html>
- **Master of academic studies** 60 ECTS: Electric power engineering and industrial systems
  - Output: Master of Electrical Engineering and Industrial Systems (300 ECTS)
  - <https://etf.unibl.org/studiranje/2-ciklus/osnovne-informacije/https-etf-unibl-org-index-php-sr-rs-studiranje-2-ciklus-osnovne-informacije-id-879.html>

# Software electroenergetics

- **Software electroenergetics involves** use of software tools and technologies to manage, optimize, and analyze electrical energy systems and networks
- **The advancement** of information and communication technologies, intelligent control systems, and artificial intelligence **underscores the need** for training of personnel in the field of electroenergetics.
- **The main arguments for education** in this field are
  - to overcome overall system complexity
  - to make maintenance more efficient and to prevent problems or failures
  - to develop advanced software tools and to innovate
- However, **it poses a challenge** in the development of educational programs and curriculum structures



# Software electroenergetics

- **Overcoming the system complexity**
  - Power systems are becoming increasingly complex, especially with the increasing introduction of renewable energy sources and smart grids. Staff training in software power engineering enables experts to understand this complexity and effectively manage modern energy systems.
- **Development of advanced software tools**
  - Staff training enables the development and implementation of advanced software tools specific to power engineering. These tools may include grid management systems, simulation and prediction tools, data analysis software, and other applications that improve the efficiency and reliability of power systems.

# Software electroenergetics

- **Solving specific challenges**
  - Software power engineering deals with specific challenges such as management of distributed energy sources, integration of renewable energy sources, optimization of consumption and reduction of network losses.
- **Innovations**
  - The training of personnel in software power engineering encourages innovations in this area. Experts trained in this field are capable of developing new technologies, algorithms and approaches that improve the efficiency and reliability of power systems.
- **Prevention of problems and failures**
  - Experts trained in software power engineering are able to identify potential problems and failures before they happen, using predictive algorithms. This enables preventive maintenance and minimizes interruptions in energy supply.

# Software electroenergetics

- Theoretical proposal of a possible study program of the first cycle of studies

First year					
1. semester	1	OB	Basics of electrical engineering 1	3+2	8 ECTS
	2	OB	Mathematics 1	3+2	8 ECTS
	3	OB	Basics of computer technology	3+2	8 ECTS
	4	OB	Physics	2+2	6 ECTS
2. semester	5	OB	Basics of electrical engineering 2	3+2	8 ECTS
	6	OB	Mathematics 2	3+2	8 ECTS
	7	OB	Basics of programming	3+2	8 ECTS
	8	OB	English language 1	2+2	6 ECTS

# Software electroenergetics

- Theoretical proposal of a possible study program of the first cycle of studies

Second year					
3. semester	1	OB	Probability and Statistics	3+2	8 ECTS
	2	OB	Theory of electric circuits	3+2	8 ECTS
	3	OB	Electronics in the electro energetics	2+2	6 ECTS
	4	CH1	Data structure and algorithms	3+2	8 ECTS
Computer networks			3+2	8 ECTS	
4. semester	5	OB	Electromagnetics	3+2	8 ECTS
	6	OB	Electrical measurements	3+2	8 ECTS
	7	OB	Signals and systems	3+2	8 ECTS
	8	OB	English language 2	2+2	6 ECTS

# Software electroenergetics

- Theoretical proposal of a possible study program of the first cycle of studies

Third year					
5. semester	1	OB	Power plants and switchgear	3+2	8 ECTS
	2	OB	Electric transformers	3+2	8 ECTS
	3	OB	Electric rotary machines	3+2	6 ECTS
	4	CH2	Solar energy sources	2+2	8 ECTS
	Designing renewable energy sources		2+2	8 ECTS	
6. semester	5	OB	Energy converters	3+2	8 ECTS
	6	OB	Electrical installations and lighting	3+2	8 ECTS
	7	CH 3	Smart electrical installations	3+2	8 ECTS
			Wind generators	3+2	8 ECTS
	8	OB	English language 3	2+2	6 ECTS

# Software electroenergetics

- Theoretical proposal of a possible study program of the first cycle of studies

Fourth year					
7. semester	1	OB	Electric vehicles	3+2	8 ECTS
	2	OB	Quality of electricity	3+2	8 ECTS
	3	CH4	Transmission and distribution of electricity	3+2	8 ECTS
			Relay protection	3+2	8 ECTS
4	CH5	Smart distribution networks	2+2	6 ECTS	
		Smart measuring devices in the power industry	2+2	6 ECTS	
8. semester	5	OB	Energy storage	3+2	8 ECTS
	6	CH6	Electric vehicles	3+2	8 ECTS
			Integration of renewable energy sources	3+2	8 ECTS
	7	CH7	Measuring transducers in the power industry	2+2	6 ECTS
			Software tools in electrical engineering	2+2	6 ECTS
8	OB	Final work	3+2	8 ECTS	

# Undergraduate studies

- Faculties and departments
  - Faculty of Business Economics (FBE)
  - Faculty of Computing and Informatics (FCI)
  - Faculty of Law (FL)
  - Faculty of Philology (FP)
- Faculty of Computing and Informatics
  - 4 year studies, 240 ECTS
  - Computing and Informatics
    - Academic title of Bachelor of Arts in Computing and Informatics
  - Information technologies
    - Bachelor of Science in Information Technology

Computing And Informatics	Information Technologies
<b>1st year</b>	
Informatics	The Law
Mathematics	Mathematics
Programming 1	Introduction to Programming
English language 1	English language 1
Discrete Mathematics	Economics
Information Technology Fundamentals	Information Technology Fundamentals
Algorithms and Data structures	Management
Psychology	Psychology
<b>2nd year</b>	
Programming 2	Computer networks
Operating Systems	Project Management
English language 2	Marketing
Internet marketing	Databases
Elective Course 1	Computer Systems
Information Systems in Distribution Channels	Multimedia
Probability and Statistics	Internet marketing
Management	English language 2
Analysis and Data Processing	
Programming Languages	
Computer Networks	
<b>3rd year</b>	
Databases	Information Systems
Internet Technologies	Web platforms
Multimedia	Second Foreign Language 1
English language 3	German language 1
Information Systems	Italian language 1
Cryptology	Elective Course 1
Second Foreign Language 1	Business Finance
Italian language 1	Accounting
German language 1	Information Systems Security
Elective Course 2	Information System Design
Computer Graphics	Elective Course 2
Artificial Intelligence	Sales management
Fundamentals of Information Theory and Coding	Web design
	English language 3
<b>4th year</b>	
Electronic Business Communication	Decision Support System
Decision Support System	Elective Course 3
Applicative Software Development	Entrepreneurship
English language 4	Distributed computer services
Information System Design	Digital Forensics
Elective Course 3	Second Foreign Language 2
Project assignment - Systems Programming	German language 2
Project assignment - Internet & Web Technologies	Italian language 2
Project assignment - Information Systems Security	Elective Course 4
Second Foreign Language 2	Business Analytics and Reporting
Italian language 2	Electronic Business
German language 2	English language 4
	Internet & Web Technologies
	Practical Research and Business Skills

# Master studies

- Faculty of Computing and Informatics
  - 1 year (2 semester) studies, 60 ECTS
  - **Contemporary Information Technologies** study program, 5 study options
    - S Information Security Systems
    - D Digital Forensics Technologies
    - C Contemporary Information Systems
    - W Modern Web Applications
    - R Computer systems in traffic safety

## 1st semester

### Mandatory

Scientific Research Methodology

Contemporary Computer Networks

### Elective course 1

Z Computer Networks Security

F Process Management in Information Systems

S Internet marketing

W Contemporary Web Technologies and Applications

R Improving traffic safety using IoT (CSTS)

R Application of computer vision in traffic control (CSTS)

## 2nd semester

### Elective course 2

Z Generation and Distribution of Cryptographic Keys

F Digital Forensics

S Innovation Management

W Intelligent Technology Application in Contemporary Business Systems

R Databases in traffic and traffic engineering (CSTS)

R Intelligent traffic systems (CSTS)

### Mandatory 2

Research Paper

Student Internship

Master's thesis



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# Contemporary Information Technologies

Nr.	Courses	S	Course status	Hours			ECTS
				L	E	Other	
1.	Scientific Research Methodology	1	O	4	3	-	10
2.	Contemporary Computer Networks	1	O	4	3	-	10
Elective courses 1 (select 1 out of 5 elective fields)							
3.	Computer Network Security (CNS)	1	E	4	3	-	10
4.	Process Management in Information Systems (DF)	1	E	4	3	-	10
5.	Internet marketing (SIS)	1	E	4	3	-	10
6.	Contemporary Web Technologies and Applications (SWTA)	1	E	4	3	-	10
7a.	Improving traffic safety using IoT (RSBS)	1	E	4	3	-	10
7b.	Application of computer vision in traffic control (RSBS)	1	E	4	3	-	10

S = semester; L = lectures; E = exercises; Course status: O = obligatory; E = elective.

Elective lines: Information Systems Security (ZIS), Digital Forensics (DF), Contemporary Information Systems (SIS), Contemporary Web Technologies and Applications (SWTA), Information systems in traffic safety (RSBS);

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# Contemporary Information Technologies

Nr.	Courses	S	Course status				ECTS
				L	E	Other	
8.	Generation and Distribution of Cryptographic Keys (ZIS)	2	E	3	2	-	8
9.	Digital Forensics (DF)	2	E	3	2	-	8
10.	Innovation Management (SIS)	2	E	3	2	-	8
11.	Intelligent Technology Application in Contemporary Business Systems (SWTA)	2	E	3	2	-	8
12a.	Databases in transport and traffic engineering (RSBS)	2	E	3	2	-	8
12b.	Intelligent traffic systems (RSBS)	2	E	3	2	-	8
13.	Research paper	2	O	-	-	4	6
14.	Student Internship	2	O	-	-	4	6
15.	Master thesis	2	O	-	-	7	10
<b>Total ECTS =</b>							<b>60</b>

S = semester; L = lectures; E = exercises; Course status: O = obligatory; E = elective.

Elective lines: Information Systems Security (ZIS), Digital Forensics (DF), Contemporary Information Systems (SIS), Contemporary Web Technologies and Applications (SWTA), Information systems in traffic safety (RSBS);

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# Contemporary Information Technologies

- The upgrades of the study program could be achieved by incorporating an additional study option focused on the Smart Electric Power Grid.
  - The focus will be on education of professionals capable of working across various sectors concerning renewable energy sources, their integration into intelligent power grids, and the utilization of AI and IoT technologies in power grid modeling.
- Graduates will be able to participate in the activities of state agencies, such as the Regulatory Agency for Energy in both entities and national levels, the Institute for Standardization of BiH, and other governmental bodies in formulating regulations and laws pertaining to smart Electric Power Grids and the deregulation of the electricity market.

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# Contemporary Information Technologies

- This study option will be focused on special aspects of design of modern computer networks in the power systems within the obligatory subject of **Contemporary Computer Networks**.
- Introduction of new subjects in two elective blocks:
  - Elective block 1
    - Integration of renewable energy sources into the Electric Power Grid
    - Software modeling of the use of solar energy and wind energy
  - Elective block 2
    - Smart systems for measurement and monitoring in Electric Power Grids
    - IoT infrastructure in Smart Electric Power Grids.