STUDY PROGRAMME ENVIRONMENTAL ENGINEERING

MASTER ACADEMIC STUDIES

Study programme name:	**Environmental Engineering**
Higher education institution in which the study programme is implemented:	**University of Niš, Faculty of Occupational Safety in Niš**
Educational / educational-scientific field:	**Technical and technological sciences**
Scientific, professional, or artistic discipline:	**Environmental and Occupational Safety Engineering**
Type of studies:	**Master academic studies**
Scope of studies in ECTS credits:	**60 ECTS credits**
Degree title:	**Master in Environmental Engineering**
Duration of studies:	**1 year**
Maximum number of students to enrol in the study programme:	**32**
Language in which the study programme is implemented:	**Serbian**

STUDY PROGRAMME OBJECTIVES

Objectives of the master academic studies study programme **Environmental Engineering** stem from the primary commitments and Strategic documents of the Faculty of Occupational Safety in Niš as a scientific-educational institution, as well as from the study programme purpose.

The **aim** of the study programme is to enable students to apply scientific and professional knowledge to solve the problems of environmental protection and improvement and to acquire knowledge and develop competences for environmental quality management.

Programme **objectives** include the acquisition of knowledge and skills for:

- Environmental impact analysis of technological processes and implementation of safety measures to reduce environmental impact risk;
- Environmental noise protection;
- Solution of problems in urban environments;
- Application and development of environmental project management;
- Identification of deficiencies and assessment of possibilities to improve industrial products in terms of environmental protection, energy efficiency, and use of secondary raw materials;
- Acquisition of knowledge about energy efficiency, resources, and methods of using renewable energy sources;
- Human impact assessment of EM radiation and implementation of safety measures;
- Environmental management, monitoring, and control;
- Use of information systems in environmental protection;
- Development and implementation of policies and strategies of sustainable development and environmental protection;
- Acquisition of knowledge about harmful environmental agents, toxic effects of chemical substances and strategies for fighting against their harmful effects;
- Acquisition of knowledge about the fundamentals of system engineering and about models and methods of decision making and effectiveness assessment;
- Critical analysis of current environmental problems and particularities of studying and solving them;
- Innovative activities and team work;
- Human resource management and development in environmental protection;
- Permanent education and development of a knowledge system in sustainable development and environmental protection.

STUDY PROGRAMME OUTCOMES – STUDENTS' COMPETENCES UPON PROGRAMME COMPLETION

Completion of the Environmental Engineering study programme provides students with the following **general competences**:

- Analysis of environmental problems;
- Prediction of solutions and consequences in the field of environmental protection;
- Mastering of methods, procedures, and processes of risk identification;
- Development of critical thinking and integrated approach to environmental protection;
- Practical application of knowledge;
- Development of communication skills in the immediate and broader surrounding;
- Development of professional ethics.

- Upon completion of the study programme, students will also acquire the following **course-specific**, or professional, **competences**:

- Assessing ecological risk;
- Developing local strategies of sustainable development and environmental protection;
- Conducting environmental impact assessment and studies on impact assessment and strategic impact assessment;
- Conducting studies on hazardous material risk assessment;
- Devising plans and programs for prevention of accidents from hazardous materials, mitigation, and recovery;
- Implementing integrated pollution prevention and control and creating documentation for an integrated licence;
- Assess effectiveness and efficiency of processes, equipment, and devices in terms of compliance with environmental protection measures;
- Designing systems and devising and implementing plans and programs for environmental monitoring;
- Developing and updating a registry of environmental conditions and pollutants;
- Preparing reports and reporting on the state of the environment;
- Implementing waste and hazardous material management;
- Establishing and developing an integrated management system;
- Supervising environmental protection;

- Organizing environmental protection in business systems;
- Educating and managing knowledge in environmental protection;
- Managing projects and innovations in the environmental protection system;
- Developing metrics and methods for effectiveness assessment of the environmental protection system;
- Using information and communication technology in environmental engineering.

Students with a master's degree in environmental engineering are able to pursue specialist and doctoral academic studies in the same or related fields of study.

STUDY PROGRAMME PURPOSE

The purpose of the master academic studies study programme Environmental Engineering is to educate students to receive a master's degree in environmental engineering, thus meeting the needs of the society and offering the possibility of further academic progress in keeping with environmental protection and sustainable development future demands. The study programme is designed to facilitate the acquisition of competences and development of academic skills in environmental engineering. In view of the importance of environmental protection as an essential determinant of sustainable development in the future, professionals in this field possess socially justifiable and usable competences.

Scientific disciplines at this level of studies allow students to master specific theoretical knowledge and applicative skills regarding environmental protection and to develop critical thinking and ability to work as part of a team. The versatility of elective courses encourages not only individuality and creativity in tailoring one's own course of studies, but also innovative and multidisciplinary approaches to environmental protection and improvement. This study programme offers possibilities to acquire basic scientific research competences and to develop professional and methodological culture to be able continue with one's education by pursuing specialist or doctoral academic studies.

ADMISSION REQUIREMENTS

The Faculty of Occupational Safety will enrol 32 students in the first year of master academic studies study programme Environmental Engineering. The number of students was established based on society's needs for the education

of professionals for the protection of employees and material and natural resources, as well as based on the resources of the faculty and the interest expressed by the applicants.

The admission procedure is regulated by the Law on Higher Education, the Statute of the University of Niš, the Statute of the Faculty of Occupational Safety, the Regulations on Master Academic Studies at the Faculty of Occupational Safety in Niš, and the Call for Admissions to the first year of master academic studies at state-founded faculties. The Call for Admissions designates the number of students (total and by source of financing), admission deadlines, admission procedures, admission requirements, criteria for applicant ranking, manner and deadlines for formal complaints regarding the ranking, and the amount of tuition fee for the self-financing students.

To be eligible to apply for enrolment in the first year of master academic studies, a person must have met one of the following requirements:

- Completed basic academic studies in a corresponding or related educational-scientific field with a minimum of 240 ECTS credits;
- Obtained a higher education degree in a corresponding or related educational-scientific field in the duration of at least four years (eight semesters) according to the rules that were in force until the day the current Law on Higher Education came into force.

Applicants who completed the basic studies at the Faculty of Occupational Safety in Niš in the duration of four years (eight semesters) according to the rules that were in force until the day the current Law on Higher Education came into force are eligible to enrol in the master academic studies pursuant to the Faculty's Educational and Scientific Council's decisions No. 03-163/13, 03-163/14, and 03-163/15 from 10 April 2019. The decisions can be downloaded at

https://www.znrfak.ni.ac.rs/SERBIAN/011-03-01-MAS-OglasnaTabla.html

Applicants who completed the basic academic studies (180 ECTS) and master academic studies (120 ECTS), with a total of at least 300 ECTS in a corresponding or related educational-scientific field are also eligible to enrol in the first year of master academic studies provided that:

- they submit a written request no later than the deadline expiration for enrolment into the following academic year;
- the faculty possesses spatial and other resources;
- that the number of enrolled students has not reached the allowed maximum (32).

Foreign citizens may enrol in the study programme under the same conditions as Serbian citizens, the only added requirements being that their application submission has to contain a recognised diploma of previous education and the number of ECTS awarded or proof of the initiated diploma recognition

procedure, proof of knowledge of the Serbian language in accordance with the Statute of the University of Niš (this requirement does not apply to applicants from former Yugoslav republics), as well as proof of health insurance.

Study programme admission requirements, corresponding or related educational-scientific fields, and preliminary and final applicant ranking re defined by the Regulations on Master Academic Studies at the Faculty of Occupational Safety in Niš (No. 03-230/4 from 2 July 2019), which can be downloaded at

http://www.znrfak.ni.ac.rs/SERBIAN/009-1-08-ZAKONI_Fakultet.html

STUDENT GRADING AND PROGRESS

Students' knowledge is continually tested and evaluated throughout the semester, while the final grade is given at the exam in accordance with the law and general acts. The evaluation is performed by awarding points for any type of activity and testing during the semester (pre-exam requirements) and at the exam itself, where the final grade is given according to the number of points awarded.

The pre-exam requirements are evaluated according to the following criteria:

- active participation during lectures and exercises – up to 10 points;
- project assignment –20 to 30 points;
- term papers and technical drawing assignments – 10 to 20 points;
- homework assignments (arithmetic problems, topic presentations, essays, etc.) – up to 5 points;
- preliminary exams (colloquia) – 15 to 30 points;
- laboratory practice and report completion – up to 10 points;
- participation in seminars – up to 10 points.

The study programme defines the following point distribution: a maximum of 60 points for activities and assignments during the semester (pre-exam requirements) and a maximum of 40 points for the final exam.

When the students have fulfilled all their pre-exam requirements, the teachers are obligated to enter the evaluation results (points) and the dates of completion into the student index no later than the day of the final exam. When all classes in a semester have ended, the structure and the total number of points awarded to students as part of their pre-exam requirements are published on the students' noticeboard and the faculty website.

By meeting the pre-exam requirements and completing their exams, students can receive a maximum of 100 points. For each specific course, students who have met all the pre-exam requirements specified in the syllabus and received a minimum of 30 points are eligible to take the exam.

Students may take the exam after all classes for the course have ended, during the terms determined by the law and the Regulations on Master Academic Studies at the Faculty of Occupational Safety in Niš. Exams are only written, only oral, or both written and oral. Students' exam achievements are graded from 5 (failed) to 10 (exceptional). The final exam grade is based on the total number of points the students received after meeting their pre-exam requirements and taking the exam; according to the following grading:

- from 91 to 100 points – grade 10 = exceptional;
- from 81 to 90 points – grade 9 = excellent;
- from 71 to 80 points – grade 8 = very good;
- from 61 to 70 points – grade 7 = good;
- from 51 to 60 points – grade 6 = sufficient;
- up to 50 points – grade 5 = failed.

The final exam grade and the total number of points received from the pre-exam requirements and the exam itself are entered into exam records, into the student index, and into the individual student's exam application, and then validated by the professor's signature. Grade 5 (failed) is not entered into the student index. The faculty is obligated to keep permanent records of all completed exams.

SELECTION OF COURSES FROM OTHER STUDY PROGRAMMES

If they so choose, students may attend and take the exam for a course taught at another study programme at the faculty or another higher education that is unrelated to any of the courses in their selected study programme at the faculty. The number of ECTS credits thus received will not be included in the total number of points received at the students' selected study programme, which is used in the student ranking for state-budget coverage of the tuition fee. In addition, the grade received at the exam for such an unrelated course will also not be included in the grade average during the studies. Mutual rights and obligations of the higher education institutions involved, including the method of financing and the students' rights and obligations, are regulated by an inter-

institutional agreement. The diploma supplement issued to students includes the number of ECTS credits received for completing the unrelated course.

Students of the faculty may complete a portion of their study programme through a compatible study programme at another higher education institution provided an agreement on ECTS credit recognition has been signed between the faculty, or the university, and the other higher education institution (the so-called student mobility). The portion of the study programme students complete at another higher education institution may include one or more courses.

An exam completed at another higher education institution may be recognized provided that the course belongs to a compatible study programme of the same level and type of studies and has a syllabus that is compatible with the corresponding course at the Faculty of Occupational Safety. To have their exam recognized, students are required to submit an exam recognition request, a certificate of exam completion, compatible study programme details, and the proof of payment of exam recognition fees. The decision on the exam recognition is made by the Teaching Committee with consent from the teacher of the given course.

REQUIREMENTS FOR SWITCHING STUDY PROGRAMMES

Considering that the master academic studies last only one year, it is not possible to switch study programmes at the faculty or another higher education institution during the school year.

Students of master academic studies at the faculty or another higher education institution may enrol in another study programme at the faculty through reapplying for master academic studies. Upon successful admission, students may submit a request for the recognition of exams completed during their previous master academic studies.

An exam completed within another study programme at the faculty or at another higher education institution may be recognized provided that the course belongs to a compatible study programme of the same level and type of studies and has a syllabus that is compatible with the corresponding course at the selected faculty. To have their exam recognized, students are required to submit an exam recognition request, a certificate of exam completion, compatible study programme details, and the proof of payment of exam recognition fees. The decision on the exam recognition is made by the Teaching Committee with consent from the teacher of the given course.

STUDY PROGRAMME STRUCTURE

The master academic studies (MAS) study programme Environmental Engineering comprises the following elements stipulated by the Law on Higher Education: study programme name and objectives; type of studies and results of the learning process; academic degree; study programme admission requirements; list of required and elective courses with course outlines; procedure and duration of studies; credit value (ECTS) of courses and the master's thesis; course pre-requirements; procedure for selecting courses from other study programmes; and requirements for switching study programmes within the same or related fields of study.

The study programme structure complies with the Accreditation Standards for the First and Second Level of Higher Education.

The study programme lasts one year (2 semesters) and comprises 60 ECTS credits.

The study programme is implemented through:

- Required courses, which include the fundamental knowledge students need to acquire;
- Elective courses, which help students shape their educational profile more closely;
- Internship, which students do in the second semester; and
- Master's thesis, which students complete in the second semester.

The study programme comprises five required and three elective courses out of 14 offered, internship, and the master's thesis. Each course comprises a specific number of ECTS credits. The electivity factor of the study programme is 36.67 %.

Within the study programme structure, the percentage of different course types is as follows:

- Theoretical-methodological 24.50 %;
- Scientific-professional 26.50 %;
- Professional-applicative 49.00 %.

Total student activities comprise active classes (lectures, exercises, laboratory work, term papers, and other forms of active classes), individual work, preliminary exams (colloquia), examinations, writing of the master's thesis, and other activities. The average number of active classes per week is 19.76-20.00 (19.84 weekly average). The total number of lecture classes within the study programme is 16 (8.00 weekly average), the number of exercise classes is 15-16 (7.67 weekly average), other forms of active classes 0-0.53 (0.18 weekly average),

research study 8 (4.00 weekly average), and other classes 10 (5.00 weekly average). The remaining time of the 40-hour work week is dedicated to other individual student activities.

Internship is an integral part of the study programme. It is done in pertinent scientific research institutions, organizations dedicated to innovation activities, organizations providing infrastructural support to innovation activities, companies, and public institutions, all for the purpose of enabling students to practically apply their acquired knowledge to solving current problems of occupational safety engineering. It comprises 3 ECTS credits.

The study programme is completed upon completion and public defence of the master's thesis. Through their master's thesis, students demonstrate their ability to synthesize and apply the acquired theoretical and practical knowledge to solving occupational safety engineering problems in organizations as well as in their local community. The master's thesis comprises 12 ECTS credits in total, of which the research study comprises 8 and the writing and defence of the thesis 4 ECTS credits.

Upon completion of the studies, students receive the academic degree

Master in Environmental Engineering

COURSE DISTRIBUTION BY SEMESTER AND YEAR OF STUDY

#	Code	Course name	Term paper	Active classes				Oth.	ECTS	Required/ Elective (R/E)	Course type
				Le.	Ex.	Oth.	RS				
FIRST YEAR											
1.	19.MZZS01	Technological Processes and the Environment	1	2	2	0	0	0	6	R	TM
2.	19.MZZS02	Environmental Noise Control	1	2	2	0	0	0	6	R	PA
3.	19.MZZS03	Renewable Energy Sources	1	2	2	0	0	0	6	R	SP
4.	19.MZZS04	Monitoring of Air Pollution and Air Quality	1	2	2	0	0	0	6	R	PA
5.	19.MZNR04	Electromagnetic Radiation Safety	1	2	2	0	0	0	6	E	PA
	19.MZZS05	Biochemistry and Biotechnology in Environmental Protection	1	2	2	0	0	0	6	E	TM
	19.MZZS06	Ecotoxicology	1	2	2	0	0	0	6	E	SP
	19.MZZS07	Water Quality Monitoring	1	2	2	0	0	0	6	E	PA
	19.MZZS08	Life Cycle Analysis	1	2	2	0	0	0	6	E	SP
6.	19.MZZS09	Urban Ecology	2	2	2	0	0	0	5	R	SP
7.	19.MMZS11	Information and Public Relations	2	2	2	0	0	0	5	E	TM
	19.MZNR10	Human Resource Management and Development	2	2	2	0	0	0	5	E	TM
	19.MMZS12	Local Sustainable Development	2	2	2	0	0	0	5	E	SP
	19.MMZS07	Environmental Policy	2	2	2	0	0	0	5	E	TM
	19.MZZS10	Social Ecology	2	2	2	0	0	0	5	E	TM
	19.MZZS11	Environmental Management	2	2	2	0	0	0	5	E	TM
8.	19.MZNR13	Information Systems in Safety	2	2	1	0.53	0	0	5	E	SP
	19.MZNR14	Systems Engineering	2	2	2	0	0	0	5	E	TM
	19.MZNR16	Project Management	2	2	1	0.53	0	0	5	E	TM
9.	19.MZZS12	Internship	2	0	0	0	0	6	3	R	PA
10.	19.IZS13A	Master's Thesis – Research	2	0	0	0	8	0	8	R	PA
11.	19.IZS13B	Master's Thesis – Writing and Defence	2	0	0	0	0	4	4	R	PA
Total classes (lectures/exercises + other) and credits				16	15-16	0-0,53	8	10	60		
Total active classes per year				39.53-40.00				10	60		

Abbreviations:

- Le. – Lectures
- Ex. – Exercises
- Oth. – Other forms of classes
- RS – Research study
- TM – Theoretical-methodological
- SP – Scientific-professional
- PA – Professional-applicative

LIST OF REQUIRED COURSES

1. Technological Processes and the Environment
2. Environmental Noise Control
3. Renewable Energy Sources
4. Monitoring of Air Pollution and Air Quality
5. Urban Ecology
6. Internship
7. Master's Thesis – Research
8. Master's Thesis – Writing and Defence

Course name: Technological Processes and the Environment		
Course status: Required	**Course code:**	19.MZZS01
ECTS credits: 6		
Requirements: -		

Course aim

Acquisition of knowledge necessary for the analysis of the environmental impact of technological processes.

Learning outcome

Acquisition of knowledge and skills for:

- identification of pollutants and energy in technological processes;
- control of processes and operations in terms of environmental protection.

Course outline

Theoretical lessons

Technological system – environment as a system: Technology and technological system; Environment as a system; Connectedness of elements in a system according to the law on conservation of mass and energy; Selection of input and output elements of technological processes from the environmental protection perspective. **Technological processes in metallurgy and the environment**: Iron production; Copper production; Lead and zinc production; Aluminium production. **Technological processes in the metalworking industry and the environment**: Mechanical metal processing; Thermal and thermochemical metal processing; Degreasing; Corrosion; Galvanic metal processing; Application of coatings. **Technological processes in inorganic chemical industry and the environment**: Sulphuric acid production; Nitric acid production; Phosphoric acid production; Sodium hydroxide, chlorine, and hydrochloric acid production; Ammonia production; Artificial fertilizer production; Sodium polyphosphate production; **Technological processes in organic chemical industry and the environment**: Detergent production; Soap production; Pulp and paper production; Paint and varnish production; Plastic mass production; Rubber production. **Technological processes of non-metal production and the environment**: Mortar binder production; Lime production; Cement production; Plaster production; Glass production. **Technological processes in food industry and the environment**: Milk and dairy production; Meat production and processing; Bread production; Non-alcoholic drink production; Alcoholic drink production; Tobacco production and processing.

Practical lessons

Auditory and calculation exercises, which successively follow the theoretical lessons; analysis of practical examples for determining critical control points of technological processes in the environment. Exercises include the defence of a term paper pertaining to the analysis of the environmental impact of technological processes. Research study within industry practice is encouraged.

Literature

[4.] Krstić Ivan (2018). *Tehnološki sistemi i zaštita*. Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

[5.] Anđelković Branislav, Krstić Ivan (2002). *Tehnološki procesi i životna sredina*. Niš: Jugoslovenski savez Društava inženjera i tehničara zaštite.

[6.] Marković Dragan, Đarmati Šimon, Gržetić Ivan, Veselinović Dragan (1996). *Fizičko-hemijski osnovi zaštite životne sredine*. Beograd: Tehnološko metalurški fakultet u Beogradu.

[7.] Hodolič Janko, Badida Miroslav, Majernik Milan, Šebo Dušan (2003). *Mašinstvo u inženjerstvu zaštite životne sredine*. Novi Sad: Univerzitet u Novom Sadu, Fakultet tehničkih nauka.

<table>
<tr><td colspan="10">Number of active classes (weekly)</td></tr>
<tr><td>Lectures</td><td>2</td><td>Auditory exercises</td><td>2</td><td>Other forms of classes</td><td>-</td><td>RS</td><td>-</td><td>Other classes</td><td>-</td></tr>
<tr><td colspan="10">Teaching methods
Lectures, auditory (calculation) exercises, office hours. Interactive work with students.</td></tr>
<tr><td colspan="10">Grading (maximum number of points: 100)</td></tr>
<tr><td colspan="4">Pre-exam requirements</td><td>Points</td><td colspan="3">Exam</td><td colspan="2">Points</td></tr>
<tr><td colspan="4">Activity during lectures</td><td>5</td><td colspan="3">Written exam (practical part of the exam)</td><td colspan="2">10</td></tr>
<tr><td colspan="4">Activity during exercises</td><td>5</td><td colspan="3">Oral exam (theoretical part of the exam)</td><td colspan="2">30</td></tr>
<tr><td colspan="4">Colloquium 1</td><td>20</td><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="4">Colloquium 2</td><td>20</td><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="4">Term paper</td><td>10</td><td colspan="3"></td><td colspan="2"></td></tr>
</table>

Course name: Environmental Noise Control		
Course status: Required	**Course code:**	19.MZZS02
ECTS credits: 6		
Requirements: -		

Course aim

Acquisition of theoretical and practical knowledge to solve specific environmental issues caused by noise sources by identifying and describing the sources and implementing noise control measures.

Learning outcome

Students' ability to:

- calculate the noise levels from road, rail, and air traffic and industrial noise sources;
- use advanced techniques for environmental noise measurements;
- use software solutions for modelling and mapping noise levels;
- use noise for diagnostic purposes;
- calculate sound control using the methods of sound absorption and sound isolation and using barriers for outdoor sound control.

Course outline

Theoretical lessons

Wave equation: Continuity equation. Equation of motion. Wave equation derivation. Wave equation solution in the Cartesian and spherical coordinate systems. Plane waves and spherical waves. **Noise sources and their characteristics:** Road, rail, and air traffic, industry, construction machinery, public utility vehicles. Residential noise. **Nosie level calculation:** Road, rail, and air traffic; industry. **Noise modelling and mapping:** Types of noise sources. Noise prediction models. Noise mapping. strategic noise maps. Acoustic zoning. Use of software tools for acoustic mapping and strategic noise maps. **Advanced noise-measuring techniques.** Uttended and unattended long-term noise monitoring. Narrow-band and bandwidth frequency analysis of noise. Sound intensity measurement. **Diagnostic use of noise:** Identification of noise sources based on the spectral content of noise. Identification of noise sources using the sound intensity method. **Noise control:** Basic principles. Source noise control (source shielding, antivibration foundation). Transmission path control. Noise control in receptions. Sound isolation and absorption, sound isolation of buildings, classification of partitions by construction. **Acoustic treatment of rooms:** Reasons for acoustic treatment of rooms. Effects of acoustic treatment of rooms. Acoustic treatment materials (porous absorbers, mechanical resonators, acoustic resonators). Comparison of acoustic materials. Calculation of noise level reduction. **Sound reduction index of single-panel partitions:** Resonance region of a homogeneous single-panel partition. Mass-law region. Coincidence effect. Calculation of sound reduction index of single-panel partitions. **Sound transmissibility of floor constructions:** Materials and structures for reducing sound transmissibility. Calculation of floating floor sound transmissibility. **Calculation of sound control for construction elements, noise control of installations, noise form machine elements. Noise control barriers:** Types of barriers. Calculation of noise reduction using barriers.

Practical lessons

Calculation exercises are dedicated to practical problems in accordance with the theoretical lessons, thus contributing to a better understanding of the topics and complementing the acquired knowledge. Practical lessons involve the calculation of noise levels from road, rail, and air traffic and industrial noise sources, as well as the calculation of sound control using the methods of sound absorption and sound isolation and using barriers for outdoor sound control outdoor sound. In addition, practical

lessons include the demonstration of advanced techniques for environmental noise measurements and the use of noise to identify its sources, as well as software for noise modelling and mapping. Students prepare to design projects pertaining to environmental noise level calculations and sound control calculations using various noise reduction methods.

Literature

[1.] Praščević Momir, Cvetković Dragan, Mihajlov Darko (2019). *Buka u životnoj sredini* – drugo dopunjeno i izmenjeno izdanje (elektronsko izdanje). Niš: Univerzitet u Nišu, Fakultet zaštite na radu.
[2.] Uzunović Ratko (1997). *Zaštita od buke i vibracija: menadžment kvalitetom i okolinom*. Beograd: Lola Institut.
[3.] Murphy Enda, King Eoin (2014). *Environmental Noise Pollution – Noise Mapping, Public Health and Policy*, Elsevier.
[4.] Kotzen Benz, English Colin (2011). *Environmental Noise Barriers – A Guide to Their Acoustic and Visual Design*. USA: NY, E&FN Spon.

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods

Lectures, auditory (calculation) exercises, office hours. Interactive work with students and use of multimedia presentations during lectures.

Grading (maximum number of points: 100)

Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Written exam (practical part of the exam)	20
Activity during exercises	5	Oral exam (theoretical part of the exam)	20
Term paper	10		
Project assignment 1	20		
Project assignment 2	20		

Course name: Renewable Energy Sources		
Course status: Required	**Course code:**	19.MZZS03
ECTS credits: 6		
Requirements: -		

Course aim

Acquisition of knowledge about the operation of facilities and devices utilizing renewable energy sources, environmental and economic aspects of using renewables, technologies for exploiting solar, geothermal, hydro, biomass, and wind energy. Another aim is to raise students' awareness of the necessity and significance of using renewable energy and preserving the environment.

Learning outcome

Students' ability to:

- understand different types of renewable energy sources;
- recognize the negative environmental impact of conventional fossil fuel energy systems;
- analyze technologies for renewable energy utilization form a systems perspective;
- perform simplified technoeconomic analyses for different types of renewable energy sources.

Course outline

Theoretical lessons

Introduction to renewable energy sources. Demand for renewable energy sources. **Properties of renewable energy sources**. **Interaction between energy and the environment.** Greenhouse effect. Global warming. Extreme meteorological conditions. **EU and national regulations for renewable energy sources. Solar energy**. The Sun as an energy source. Direct conversion of solar radiation into thermal and electric energy. **Solar panels**. Types, system configuration, installation method. **Photovoltaic panels**. Types, system configuration, installation method. **Geothermal energy**. Basic terms. Geothermal energy sources. Extraction and transport equipment. Geothermal energy application. Direct application for heating and electricity production. **Wind energy**. Basic terms. Wind turbines, aerodynamics, types, dimensions, and selection. Basic elements. Safety and control systems. Installation. Wind turbine use and environmental impact. **Hydromechanical energy**. **Biomass energy**. Basic terms. Biomass sources. Energy potential. Biomass potential in Serbia. **Biomass mechanical processing technology.** Production of briquettes, pellets, woodchips, etc. Biomass transport and storage. Environmental impact. **Biomass from livestock production**. Use in biogas production. **Biomass gasification. Technoeconomic analysis of renewable energy projects.**

Practical lessons

Expansion of the knowledge acquired during theoretical lessons, calculation problems that follow the theoretical lessons, and a project assignment involving a technoeconomic analysis of a chosen system based on renewable energy sources.

Literature

[1.] Mitić Dragan (2008). *Energija*. Niš: Univerzitet u Nišu, Mašinski fakultet

[2.] Kaltschmitt Martin, Streicher Wolfgang, Wiese Andreas (ed.) (2007). *Renewable Energy: Technology and Environment Economics*. Germany: Springer

[3.] Basu Prabir (2010). *Biomass Gasification and Pyrolysis – Practical Design and Theory*. Amsterdam: Elsevier

[4.] Vanek Francis, Albright Louis, Angenent Largus (2016). *Energy Systems Engineering: Evaluation and Implementation*. USA, NY: McGraw Hill

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<tr><td>Lectures</td><td>2</td><td>Auditory exercises</td><td>2</td><td>Other forms of classes</td><td>-</td><td>RS</td><td>-</td><td>Other classes</td><td>-</td></tr>
<tr><td colspan="10">Teaching methods
Verbal-textual method (presentations, conversations, written material), illustrations and demonstrations (power point presentations, animations, simulations), calculation exercises</td></tr>
<tr><td colspan="10">Grading (maximum number of points: 100)</td></tr>
<tr><td colspan="4">Pre-exam requirements</td><td>Points</td><td colspan="3">Exam</td><td colspan="2">Points</td></tr>
<tr><td colspan="4">Activity during lectures</td><td>5</td><td colspan="3">Oral exam (theoretical part of the exam)</td><td colspan="2">40</td></tr>
<tr><td colspan="4">Activity during exercises</td><td>5</td><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="4">Colloquium</td><td>30</td><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="4">Project assignment</td><td>20</td><td colspan="3"></td><td colspan="2"></td></tr>
</table>

Course name: Monitoring of Air Pollution and Air Quality

Course status: Required | **Course code:** 19.MZZS04

ECTS credits: 6

Requirements: -

Course aim

Acquisition of knowledge about the monitoring of air pollution from energy generating and technological emission sources, the monitoring of ambient air quality, processing of monitoring results, and monitoring reports.

Learning outcome

Students' ability to:

- monitor and measure air pollutant emissions from energy generating and technological sources and create reports on measurement results;
- monitor ambient air in urban and rural environments and measure pollutant concentrations;
- process measurement results and report on ambient air quality.

Course outline

Theoretical lessons

Definition of monitoring: General classification of monitoring. Authorized monitoring bodies. **Air pollution sources:** Pollutant Release and Transfer Register (PRTR). Local Pollutant Source Register (LPSR). General data on pollution sources. LPSR reporting. **Air pollutant emissions:** Types of emissions: continuous emission, fugitive and diffuse emissions, extraordinary emissions. Types and scope of control. Maximum mass flow rate. Maximum emission concentration and mass fraction indicator. Conditions and rules of emission measurement. **Ambient air quality monitoring**: General principles of monitoring. Monitoring system structure. Environmental information system and monitoring. Quality assurance and control in monitoring. Monitoring program. Systems for automatic ambient air monitoring. Information and software support. Data transfer networks. Monitoring network topology. Detection elements of air monitoring network. Processing of monitoring data. **National network for air quality monitoring in Serbia:** General principles of air quality monitoring. Scope and content of monitored pollutants. Measurement methods and equipment in the monitoring network. Air monitoring zones and agglomerations in Serbia.

Practical lessons

Determination of pollutant release into the air – general questions. Emission measurements. Emission calculations. Method selection. Determination of pollutant release into the air – specific aspects by sector. Work with emission measuring devices. Program for urban air quality monitoring. Conditions and rules of ambient air monitoring. Work with *Airpointer* monitoring station. Presentation and defence of term papers on topics included in the course syllabus.

Literature

[1.] Živković Nenad, Đorđević Amelija (2017). *Monitoring emisije aerozagađenja i kvaliteta ambijentalnog vazduha*. Niš: Univerzitet u Nišu, Fakultet zaštite na radu u Nišu

[2.] Deflorenne Emmanuel, Gueguen Céline, Jeannot Coralie, Nicco Laetitia, Serveau Laetitia, Vincent Julien (2017). *Priručnik za izračunavanje emisija u zrak za nacionalne E-PRTR obveznike*, Hrvatska agencija za okoliš i prirodu i organizacija CITEPA

[3.] Ilić Predrag, (2015). *Zagađenje i kontrola kvaliteta vazduha u funkciji zaštite životne sredine* Banja Luka: Nezavisni Univerzitet Banja Luka

<table>
<tr><td colspan="10">Number of active classes (weekly)</td></tr>
<tr><td>Lectures</td><td>2</td><td>Auditory exercises</td><td>2</td><td>Other forms of classes</td><td>-</td><td>RS</td><td>-</td><td>Other classes</td><td>-</td></tr>
<tr><td colspan="10">Teaching methods
Lectures, discussions, defence of term papers during exercises, and office hours</td></tr>
<tr><td colspan="10">Grading (maximum number of points: 100)</td></tr>
<tr><td colspan="4">Pre-exam requirements</td><td>Points</td><td colspan="3">Exam</td><td colspan="2">Points</td></tr>
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<tr><td colspan="4">Colloquium 1</td><td>15</td><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="4">Colloquium 2</td><td>15</td><td colspan="3"></td><td colspan="2"></td></tr>
<tr><td colspan="4">Term paper</td><td>20</td><td colspan="3"></td><td colspan="2"></td></tr>
</table>

Course name: Urban Ecology		
Course status: Required	**Course code:**	19.MZZS09
ECTS credits: 5		
Requirements: -		

Course aim

Acquisition of theoretical knowledge that enables students to identify, understand, and explain the environmental issues of urban environments and to apply adequate environmental protection measures in threatened urban areas.

Learning outcome

Students' ability to:

- apply the acquired knowledge in the field of environmental engineering to solve environmental issues in urban environments;
- use bioclimatic planning;
- solve environmental issues in residential areas;
- solve environmental issues in industrial and recreation areas.

Course outline

Theoretical lessons

City and urban functions. Functional urban zoning. Residential zone: Basic indicators of residential zones. Important urban planning parameters for the design of residential buildings. Architectural characteristics of residential buildings. Individual housing construction. Collective housing construction. Spatial and functional organization of residential zones. **Energy efficiency in building design and construction**: Requirements for energy efficiency of buildings (climatic, planning, urban planning, architectural, civil engineering, and energy requirements). Energy consumption in buildings. Conditions and measures for achieving comfort in buildings: thermal, air, light, and sound comfort. Objectives and measures for achieving energy efficiency in building design and construction. Building thermal envelope and its optimization: Optimization of surface and geometry. Thermal insulation of full segments. Thermal insulation of glazed segments. Passive use of solar radiation; active use of solar radiation. Thermal flow reduction. Insolation reduction, thermal mass, and ventilation. Envelope with photovoltaic panels. Solar technology and building envelope. Solar technology and architecture. Use of renewable energy sources in building design and construction. Green and passive buildings. **Bioclimatic planning and solar architecture:** Functional organization of indoor spaces in passive residential buildings. Orientation of passive buildings. Passive solar capture systems. Awnings, sunspaces, Trombe wall. Solar windows and direct solar capture. Water walls. Passive thermal storage roof systems. Environmental significance of using active and passive solar systems. **Urban green space and its ecological significance in urban environments:** importance of urban green space, green space regulations for urban environments, functional division of spaces intended as urban green zones, general-purpose green spaces, specificpurpose green spaces, specialized green spaces. **Industrial zone:** industrial zone size, location of industry in relation to urban and residential areas, location of industry in terms of environmental requirements. **Recreation zones in urban environments. Urban traffic and the consequent environmental issues. Urban public utility issues**: residential water supply – urban water supply systems; urban sanitation systems – urban sewerage systems; municipal waste: collection, transport, treatment methods, and deposition in sanitary landfills. **Facilities, operations, and measures for urban flood control.**

Practical lessons

Elaboration of current topics pertaining to urban environmental issues through writing and defence of term papers.

Literature

[1.] Radosavljević Jasmina (2009). *Urbana ekologija*. Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

[2.] Radosavljević Jasmina (2010). *Prostorno planiranje i zaštita životne sredine*. Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

[3.] Radosavljević Jasmina, Pavlović Tomislav, Lambić Miroslav (2010). *Solarna energetika i održivi razvoj*. Beograd: Građevinska knjiga.

[4.] Radosavljević Jasmina, Đorđević Amelija (2012). *Deponije i deponovanje komunalnog otpada*. Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods

Lectures, auditory (calculation) exercises, office hours. Interactive work with students.

Grading (maximum number of points: 100)

Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Written exam (practical part of the exam)	40
Activity during exercises	5		
Colloquium 1	20		
Colloquium 2	20		
Term paper	10		

Course name: Internship

Course status: Required	**Course code:**	19.MZZS12

ECTS credits: 3

Requirements: Internship is completed in the second semester.

Course aim

Becoming familiar with the operational process in the company (institution) in which the internship is done, with its goals, and with its organizational units. Meeting the team and learning about the project students join as part of the internship, selected according to the study programme they chose. Understanding of the work process in the company (institution), the operative processes, and occupational risks. Participation in design projects, document creation, or quality control, in keeping with the work process and the possibilities of the work environment.

Learning outcome

Students' ability to:

- improve their abilities to join the workforce after their studies;
- acquire a clear insight into the possibility of practically applying the acquired theoretical, scientific, and professional knowledge and skills covered in the study programme;
- solve specific issues in the scientific field Environmental and Occupational Engineering within the selected company or institution;
- understand the role of a person with a master's degree in environmental engineering within the organizational structure of a company or institution;
- develop responsibility, professional work approach, and team communication skills;
- use experiences of other professionals employed at the company (institution) of the internship in order to expand their practical knowledge and increase their motivation.

Course outline

Internship content is fully compliant with internship aims and is created specifically for each student, according to the activity of the company (institution) where the internship is done and according to the demands of the profession for which a student is educated. Students become familiar with the structure of the company (institution) and its operation objectives, adapt their own involvement to the study programme they chose, and regularly fulfil their work duties, which correspond to the duties of regular employees of the company (institution). Students provide an account of their involvement during the internship and critically reflect upon their experience and the knowledge and skills they acquired during the internship.

As a rule, students choose a company (institution) from the government, private, or public sector for their internship. The internship may be done in institutions within Serbia that have a written agreement with the Faculty of Occupational Safety or that give consent for accepting student interns.

At a student's proposal, the vice dean for education approves the internship at a chosen company (institution) and then issues the written internship order form. Based on the internship logbook, which needs to record at least 90 internship classes, and the certificate of internship signed by the authorized person and stamped with the company (institution) seal, confirming that the internship has been completed, the student is awarded 3 ECTS after the internship defence before the professors appointed for the defence by the Teaching and Scientific Council of the faculty.

Number of active classes (weekly)

Lectures	-	Auditory exercises	-	Other forms of classes		RS	-	Other classes	6

Teaching methods Consultations during the internship and creation of the internship logbook.
Grading (maximum number of points: 100) Completed internship and creation and defence of the internship logbook are graded using the descriptors “defended” or “not defended”.

Course name: Master's **Thesis – Research**									
Course status: Required				**Course code:**		19.IZS13A			
ECTS credits: 8									
Requirements: Enrolment in the second semester									
Course aim Use of basic, theoretic-methodological, scientific-professional, and professional-applicative knowledge and methods to solve specific problems. Individual research study, which can have a practical, investigative, or theoretical-methodological character. Acquisition of required skills through solving complex issues and problems and identification of opportunities to practically apply the previously acquired knowledge.									
Learning outcome Students' ability to: • independently formulate and analyze problems and to critically examine potential solutions; • independently apply previously acquired knowledge from the various fields they studied in order to examine the structure of a given research problem, as well as to apply systems analysis in order to draw conclusions about the possible ways of solving the given research problem; • independently use literature, thus expanding their knowledge by studying different methods and publications that deal with similar issues; • analyze and identify problems within a given topic and propose the ways to solve them; • consider the place and role of engineers in their chosen field; • develop team spirit and team-work; • apply acquired engineering knowledge and skills to solve problems in practice; • stay up to date with and utilize new developments in their profession.									
Course outline According to their preferences and affinity, students choose their research study area, specifically the course within which they will conduct their research associated with their previously approved topic of the master's thesis. The mentor defines the research study task according to the requirements, complexity, and structure of a specific research. Students study the problem and its structure and complexity, and study professional literature, including scientific and professional publications dealing with the given or similar topic; after analyzing the literature, they draw conclusions about potential problem solutions. By examining the literature, students learn about the methods used to solve similar problems and about the previous engineering practice regarding problem solution. The research study also requires students to stay up to date with primary knowledge, to organize and conduct experiments and numerical simulations, to process data statistically, and to write a research paper from the narrow scientific field of their research study topic. The mentor evaluates the research study based on a student's defence of the research paper and approves the writing of the master's thesis, which includes the results of the research study.									
Literature									
Number of active classes (weekly)									
Lectures	-	Auditory exercises	-	Other forms of classes		RS	8	Other classes	-

Teaching methods			
With the mentor's aid, students individually solve a given problem and research the subject matter, after which they write a research paper.			
Grading (maximum number of points: 100)			
Pre-exam requirements	Points	**Exam**	Points
Research paper – writing	50	Research paper – defence	50

Course name: Master's Thesis – Writing and Defence									
Course status: Required				**Course code:**			19.IZS13B		
ECTS credits: 4									
Requirements: Completion of exams for all courses in the study programme									
Course aim Combination of the theoretical background and the research study to solve a specific problem, for the purpose of examining the structure and performing a systems analysis of the problem in order to draw conclusions about the possible ways of solving it. Gaining experience of presenting the results of the research study in written form and orally, during the master's thesis defence.									
Learning outcome Students' ability to: • independently present the results of their research by writing their thesis and presenting it orally at the thesis defence; • write the thesis according to a required form; • clearly and satisfactorily elaborate on their proposed solutions to the given problem through an oral presentation of the thesis and response to the subsequent questions.									
Course outline By combining the research study and the theoretical background of the given problem, students write their master's thesis, which has to contain the following elements: abstract with key words in Serbian, table of contents, introduction, research text body (formulation of the research problem and subject matter, presentation of the current state of the given research field, theoretical or practical portion of the research, results and discussion), conclusion, list of cited literature (minimum of ten references, of which at least six have to be academic and professional publications and at least one has to be written in a foreign language), and appendices. The committee for master's thesis evaluation and defence evaluates the written thesis and approves the public oral defence of the master's thesis, which is organized before a committee of three members, one of whom is the mentor. During the oral defence, the candidate presents the results of their research and then answers the questions by committee members, thus demonstrating the ability to orally present a project.									
Literature									
Number of active classes (weekly)									
Lectures	-	Auditory exercises	-	Other forms of classes		RS	-	Other classes	4
Teaching methods With the mentor's aid, students write their master's thesis and prepare for the oral defence. Students consult with the mentor and other members of the committee for master's thesis evaluation and defence.									
Grading (maximum number of points: 100)									

Pre-exam requirements	Points	**Exam**	Points
Written thesis	30	Thesis defence	70

LIST OF ELECTIVE COURSES

1. Electromagnetic Radiation Safety
2. Biochemistry and Biotechnology in Environmental Protection
3. Ecotoxicology
4. Water Quality Monitoring
5. Life Cycle Analysis
6. Information and Public Relations
7. Human Resource Management and Development
8. Local Sustainable Development
9. Environmental Policy
10. Social Ecology
11. Environmental Management
12. Information Systems in Safety
13. Systems Engineering
14. Project Management

Course name: Electromagnetic Radiation Safety

Course status: Elective	**Course code:**	19.MZZS04

ECTS credits: 6

Requirements: -

Course aim

Acquisition of knowledge from the theory of macroscopic electromagnetic fields, EM radiation sources, and methods of calculation, measurement, and protection against EM radiation.

Learning outcome

Students' ability to understand the phenomena and principles regarding

- occupational and environmental non-ionizing EM radiation;
- procedures of EM calculation, simulation, and measurement;
- protection against quantum corpuscular radiation (UV, IR);
- protection against ionizing EM radiation;
- methods of assessing biological effects on humans and of selecting and using safety measures.

Course outline

Theoretical lessons

Introduction. Theory of EM fields and waves: Complete system of equations of macroscopic electromagnetic field in stationary environments. **Technical systems as EM radiation sources:** Telecommunication devices. Antennas and propagation of EM waves. EM energy transfer. Artificial sources of EM radiation. EM field of electrical devices. Low-frequency (transformers, power lines, electrolytic tanks, etc.) and high-frequency (radio and TV frequency, mobile communication, radars, electrothermics, etc.) EM sources. **Electromagnetic compatibility:** Basic terms, interference sources, transfer path, interference types**,** electromagnetic compatibility testing, CE marking. **Methods for EM field calculation:** Analytical and numerical methods. Modelling of objects and sources in the EM field. **Humans in EM field:** EM radiation dosimetry. Measurement of low- and high-frequency EM fields. Radiation exposure standards and regulations. Biological effects of EM radiation. **Protection against quantum corpuscular EM radiation:** Heat radiation measurement, regulation, and protection. UV radiation measurement, regulation, and protection. Ionizing radiation measurement, regulation, and protection.

Practical lessons

Exercises. Examples of the application of fundamental laws of EM field theory. Examples of calculation and simulation. Examples of creating an environmental impact assessment study. Practical measurements in the field. Examples of designing a system for the monitoring of and protection against EM fields of different frequencies.

Literature

[1.] Krstić Dejan (2020). *Elektromagnentna zračenja u životnoj sredini*. Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

[2.] Petković Dejan, Krstić Dejan, Stanković Vladimir (2008): *Elektromagnetni talasi i zračenje* (Elektromagnetna zračenja – Izvodi sa predavanja i vežbi - Sveska 5). Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

[3.] Krstić Dejan, Sokolović Dušan (2020). *Metode i rezultati istraživanja štetnog dejstva elektromagnetnih zračenja u životnoj sredini*. Niš: Univerzitet u Nišu, Fakultet zaštite na rad.

[4.] Veličković Dragan (1997). *Elektromagnetna zračenja.* Niš.

[5.] Barnes Frank, Greenebaum Ben (2007). *Handbook Of Biological Effects of Electromagnetic Fields, Bioengineering and Biophysical Aspects of Electromagnetic Fields*, 3rd ed. USA, FL: CRC Press.

Number of active classes (weekly)									
Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods

Lectures, auditory (calculation) exercises, office hours. Interactive work with students.

Grading (maximum number of points: 100)			
Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Written exam (practical part of the exam)	10
Activity during exercises	5	Oral exam (theoretical part of the exam)	30
Colloquium	30		
Term paper	20		

Course name: Biochemistry and Biotechnology in Environmental Protection

Course status: Elective | **Course code:** 19.MZZS05

ECTS credits: 6

Requirements: -

Course aim

Acquisition of basic knowledge about the structure and function of biomolecules and the basic principles of structure, function, and organization of biological systems, as well as their role in biotechnological processes for the purpose of environmental protection.

Learning outcome

Students' ability to:

- understand the basic biochemical processes;
- connect biochemical processes from the cellular level to the entire ecosystems;
- understand the fundamentals of biotechnological processes;
- develop and apply biochemical and biotechnological methods for protection and treatment of different environmental media.

Course outline

Theoretical lessons

Bioelements and biomolecules: Definition, structure and function of bioelements and basic classes of biomolecules (carbohydrates, lipids, amino acids, proteins, enzymes, nucleic acids). **Basics of physiology:** General terms about the structure and function of cells, organs, tissues, and living organisms. **Metabolism:** Metabolism of biomolecules and metabolism of xenobiotics. **Biokinetics**: General principles, mechanism and kinetics of enzyme-catalysed reactions. **Mechanisms detoxication:** Mechanisms of detoxication in plants. Mechanisms of detoxication in animals (biotransformation of xenobiotics). **Biodegradation and bioremediation:** Basic terms. Use of organisms, cells, their parts, and molecular analogues in environmental remediation and protection. Phytoremediation. Microbiological remediation. Control of bioremediation processes. **Biotechnological processes:** General biotechnology terms. Biotechnological procedures in environmental protection (wastewater treatment, biological decomposition of organic solid waste, bio-deodorization). Use of genetically modified organisms in environmental biotechnology. Bioreactors.

Practical lessons

Application of the knowledge acquired from the theoretical lessons to case study analyses. Use of biochemical and biotechnological processes for biodegradation of specific groups of compounds: heavy metals, petroleum and its products, pesticides, phenolic compounds, polychlorinated biphenyls, and azo dyes. Students write a term paper analyzing the presence of contaminants in a specific environmental medium and proposing a biochemical or biotechnological process for treatment.

Literature

[1.] Stojanović Marina, Miltojević Ana. (2019). *Biohemijski procesi – interni materijal za pripremu ispita.* Niš: Univerzitet u Nišu, Fakultet zaštite na radu u Nišu.

[2.] Strajer Lubert (1991). *Biohemija*. Zagreb: Školska knjiga.

[3.] Evans Gareth, Furlong Judith (2010). *Environmental Biotechnology: Theory and Application*. Hoboken, NJ: Wiley.

[4.] Bhattacharyya Bimal, Banerjee Rintu (2007). *Environmental Biotechnology*. Oxford: Oxford University Press.

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods Lectures, auditory exercises, office hours, term paper			
Grading (maximum number of points: 100)			
Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Oral exam (theoretical part of the exam)	40
Activity during exercises	5		
Colloquium 1	20		
Colloquium 2	20		
Term paper 1	10		

Course name: Ecotoxicology		
Course status: Elective	**Course code:**	19.MZZS06
ECTS credits: 6		
Requirements: -		

Course aim

Acquisition of knowledge about the mechanisms of toxic effects of pollutants and the toxic effects on individual organisms, populations, and ecosystems. Learning about the methods for quantifying pollutant toxicity and predicting environmental effects.

Learning outcome

Students' ability to:

- understand the basic principles of ecotoxicology;
- understand the conditions under which the effects of pollutants impact individual organisms, populations, and ecosystems;
- understand the consequences caused by pollutants;
- analyze the results of ecotoxicological examinations and analyze exposure scenarios;
- perform risk assessment, calculate parameters, and interpret results.

Course outline

Theoretical lessons

Introduction to ecotoxicology: Definition, subject matter, and tasks of ecotoxicology, basic terms and principles of ecotoxicology. **Pollutants and their fate in the ecosystem:** Primary pollutant classes (inorganic substances – metals, nonmetals, gaseous substances, radionuclides, nanoparticles, etc.; organic substances - hydrocarbons, polychlorinated biphenyls, organochloride, organophosphorus, carbamate, and pyrethroid pesticides, pharmaceuticals, etc.). Ways in which pollutants enter the environment. Factors influencing the transport and distribution of pollutants (sorption, degradation, and biodegradation of organic substances, bioaccumulation and biomagnification of persistent substances, etc.). **Impact of pollutants on individual organisms:** Exposure pathways. Toxicokinetics and toxicodynamics; Carcinogenesis, genotoxicity, mutagenesis. **Impact of pollutants on populations, communities, and ecosystems:** Population dynamics. Genetically acquired resistance to pollutants. Changes in communities and ecosystems. **Ecotoxicological risk assessment:** Biomonitoring. Biomarkers and their role in risk assessment. **Chemical accidents:** Options for prevention, action, and mitigation of harmful effects of accidents induced by toxic substances. **Regulatory aspects of ecotoxicology.**

Practical lessons

Calculations: NOAEL (no observed adverse effect level), LOAEL (lowest observed adverse effect level), TDI (tolerable daily intake), ADI (acceptable daily intake), GV (guideline value); qualitative and quantitative characterization of selected pollutants present in water, air, soil, and plants. Interpretation of results: database search for toxicity data for a given set of pollutants. Interpretation of the results obtained from the database search. Writing and defence of term papers.

Literature

[1.] Golubović Tatjana (2015). *Ekotoksikologija - interni materijal za pripremu ispita*. Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

[2.] Vitorović Slavoljub, Milošević Milenko (2002). *Osnovi toksikologije sa elementima ekotoksikologije*. Beograd: Univerzitet u Beogradu, VIZARTIS Beograd.

[3.] Jablanović Miodrag, Jakšić Predrag, Kosanović Katica (2003). *Uvod u ekotoksikologiju*. Kosovska Mitrovica: Univerzitet u Prištini, Kosovska Mitrovica.

[4.] Kastori Rudolf (1997). *Teški metali u životnoj sredini*. Novi Sad: Naučni institut za ratarstvo i povrtarstvo.
[5.] Hoffman David, Rattner Barnett, Burton Allen, Cairns John (2002). *Handbook of ecotoxicology*. Boca Raton, Florida: CRC Press.

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods
Lectures, auditory/calculation exercises, office hours

Grading (maximum number of points: 100)

Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Written exam (practical part of the exam)	20
Activity during exercises	5	Oral exam (theoretical part of the exam)	20
Colloquium 1	20		
Colloquium 2	20		
Term paper	10		

Course name: Water Quality Monitoring

Course status: Elective | **Course code:** 19.MZZS07

ECTS credits: 6

Requirements: -

Course aim

Acquisition of knowledge about the organization of water quality monitoring systems and the use of water quality testing methods aimed towards preserving the functions of aquatic ecosystems (required ecological status) and ensuring the required quality of the water intended for water supply and sanitation systems in residential areas.

Learning outcome

Students' ability to work independently in:

- operational control and management of water quality monitoring systems;
- water supply and sanitation systems of residential areas.

Course outline

Theoretical lessons

Water quality monitoring: Spatial and temporal organization of water quality monitoring systems. Definition, roles, and goals of monitoring. Types of monitoring. Structuring and design of water quality monitoring systems in a watershed area. Analytical-conceptual frameworks for the processing of obtained data. Advanced models of obtained data visualization. **Evaluation of water body status**: ecological status/potential, chemical and quantitative status of surface water bodies. **Water supply**: Drinking water properties and quality. Elements of the water supply system for the population and industry, water supply springs, and protective measures. **Drinking water distribution:** Transformation of abstracted water quality to the required hygienic safety level. Distribution network and other water supply system facilities. Operational control and management of the water supply system. **Sanitation**: Systems for reception and disposal of waste and other water. Operational control and management of the sewerage system. **Protective measures for wastewater recipients**: Monitoring of the impact of wastewaters on recipient quality. Definition of wastewater recipient protective measures in terms of emissions and emission standards.

Practical lessons

Calculation exercises and term paper – project assignment pertaining to water quality monitoring systems at specified watershed areas and design of water supply and sanitation systems for specific residential areas. Fundamentals of calculation, measurement, and control of the operation of water supply and sanitation systems.

Literature

[1.] Milojević Miloje (2003). *Snabdevanje naselja vodom i kanalisanje naselja*. Beograd: Univerzitet u Beogradu, Građevinski fakultet.

[2.] Stojanović Marina, Vasović Dejan (2019). Monitoring kvaliteta voda (*interni materijal za pripremu ispita)*. Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

[3.] Veljković Nebojša i dr (2018). *Status površinskih voda Srbije - Razvoj monitoringa u okviru planova upravljanja rečnim slivovima*. Beograd: Agencija za zaštitu životne sredine Republike Srbije.

[4.] Loucks Daniel, Beek van Eelko (2005). *Water Resources Systems Planning and Management: An Introduction to Methods, Models & Applications*. Paris: UNESCO Publishing.

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods Lectures, auditory (calculation) exercises, office hours. Interactive work with students.			
Grading (maximum number of points: 100)			
Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Written exam (practical part of the exam)	20
Activity during exercises	5	Oral exam (theoretical part of the exam)	20
Colloquium 1	15		
Colloquium 2	15		
Term paper	20		

Course name: Life Cycle Assessment

Course status: Elective	**Course code:**	19.MZZS08

ECTS credits: 5

Requirements: -

Course aim

Acquiring knowledge for systemic consideration of ecological attributes of industrial products across their life cycle stages, and for recognizing the prerequisites for efficient treatment of end-of-life durable consumer goods. Acquiring knowledge on life cycle analysis methods, tools and significance of LCA for environmentally responsible design.

Learning outcome

Students should be able to:

- recognize and compare the environmental impacts of various industrial products over their entire life cycle cycles;
- identify the deficiencies and assess the possibilities for improvement of industrial products in terms of environmental friendliness;
- apply modern tools for life cycle assessment when evaluating the environmental friendliness of industrial products.

Course outline

Theoretical lessons

Environmental friendliness of durable consumer goods: Industrial product as a system. Attributes of environmental friendliness. Multi-criteria analysis of environmental friendliness of a product (MET matrix). **Life cycle stages of an industrial product:** Extraction, production, exploitation, end-of-life treatment. **Application of LCA methods:** Categories of environmental impact. Types of LCA. **LCA implementation stages:** Aim and scope – system limits and functional unit. Life cycle inventory. Life cycle analysis and assessment: characterization and categorization, aggregation. Normalization and weighting. Interpretation and communication. **EU directives on LCA-based labelling:** Type III eco-labelling and environmental product declarations (EPD). **Software tools for life cycle assessment:** The structure, elements, graphic user interface, and introduction to LCA software packages (SimaPRO, OpenLCA and/or GaBi). Software tool for assistance with the design of eco-friendly products (SolidWORKS/Sustainability).

Practical lessons

Audio-visual exercises that follow the theoretical lessons. Analysis of case studies and examples of good engineering practice. Comparison of structures and discussion about the advantages and disadvantages in terms of environmental impact. Presentation and use of available software tools for the life cycle assessment of industrial products. Presentation and defence of a project assignment on a topic included in the course syllabus.

Literature

[1.] Glišović Srđan (2017). Sustainable Design and the Environment (in Serbian; the title of the original: *Održivo projektovanje i životna sredina*). Univerzitet u Nišu, Fakultet zaštite na radu.

[2.] Scott Matthews, Chris Hendrickson, Deanna Matthews (2014). *Life Cycle Assessment: Quantitative Approaches for Decisions that Matter*.

[3.] Baumann Henrikke, Tillman Anne-Marie (2004). *The hitchhiker's guide to LCA: an orientation in life cycle assessment methodology and application*. Lund: Studentlitteratur.

[4.] Hodolič Janko et al. (2003). *Zaštita životne sredine u mašinstvu*. Univerzitet u Novom Sadu, Novi Sad, Fakultet tehničkih nauka.

Number of active classes (weekly)									
Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods Lectures, exercises, office hours, defence of term papers			
Grading (maximum number of points: 100)			
Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Written exam (practical part of the exam)	20
Activity during exercises	5	Oral exam (theoretical part of the exam)	20
Colloquium	30		
Term paper 1	20		

Course name: Information and Public Relations		
Course status: Elective	**Course code:**	19.MMZS11
ECTS credits: 5		
Requirements: -		

Course aim

Acquisition of knowledge about methods and ways of sharing information with different target groups in order to gain communication skills necessary for the manager profession. Provision of a comprehensive view of basic concepts and principles of public relations and explanation of the role and importance of public relations.

Learning outcome

Students' ability to:

- better understand communication practice and acquire communication skills;
- understand the role and function of public relations;
- establish public relations in the fields of environmental protection and management;
- communicate for the purpose of creating, maintaining, and improving good relations with the public.

Course outline

Theoretical lessons

Information: definition and structure of information, basic characteristics of information, functions of information**. Message:** definition, structure, and types of messages, redundance, factographic and value messages. **Information sharing with the public:** definition and functions of information sharing, socially engaged and tendentious information sharing. **Communication:** definition of communication, types of communication practice: interpersonal and mass communication. **Models of information and communication systems:** origin of information and communication systems, Lasswell's, Shannon and Weaver's, Vivian's, and Vreg's information and communication systems. **Functions of information and communication systems**: basic functions and derived functions of information and communication systems. **Types of communication**: written, verbal, paraverbal, and nonverbal communication. **Receiving subsystems of information and communication systems:** mass, audience, public, target public**. Public relations**: definition and parameters, strategy of public relations, communication with the public, communication with professional circles and authorized bodies. **Methods of public relations:** press conferences, lobbying and sponsorships as a method of communication with the public. **Public relations and the environment:** importance of communication, communication strategy, creation of effective communication, plan of communication: incoming information, outgoing information, messengers, personnel, training and practice, monitoring, updates, and adjustment. Territorial and local systems of notifying and informing the public during emergencies. **Communication with the media regarding the environment**: traditional and new media**.** Local media and information about the environment. **Aarhus convention and the right of citizens to timely information about the environment**: right to information about the environment, collection and delivery of information about the environment, information and communication systems and environmental protection.

Practical lessons

Auditory exercises: discussions based on content analysis about information sharing by traditional and new media concerning the environment; discussions based on analysis of information sharing and public relations in authorized institutions, primarily the Environmental Protection Agency of Serbia with the Serbian Ministry of Environmental Protection, and the Emergency Management Sector with the Ministry of Internal Affairs; analysis of good practice examples of information sharing and of public relations; analysis of implementation of the Aarhus convention in Serbia; defence of term papers.

Literature

[1.] Stojković Branimir, Radojković Miroljub (2009). *Informaciono komunikacioni sistemi*. Beograd: CLIO
[2.] Mandić Tijana (2003). *Komunikologija–psihologija komunikacije*. Beograd: CLIO
[3.] Blek Sem (2003). *Odnosi s javnošću*. Beograd: CLIO
[4.] Bartel Van de Walle, Turoff Murray & Hiltz Starr Roxanne (2009). *Information Systems for Emergency Management*. New York & London: M.E. Sharpe
[5.] Jelenković Predrag, Jelenković Ljiljana (2012). *Odnosi s javnošću u oblasti zaštite životne sredine*. Beograd: Čigoja štampa

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods

Lectures, presentations, discussion, term papers, office hours, individual and group work

Grading (maximum number of points: 100)

Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Oral exam (theoretical part of the exam)	40
Activity during exercises	5		
Colloquium 1	15		
Colloquium 2	15		
Term paper	20		

Course name: Human Resource Management and Development		
Course status: Elective	**Course code:**	19.MZNR10
ECTS credits: 5		
Requirements: -		

Course aim

Acquisition of knowledge about basic theoretical issues of human resource management and the particularities of their development in an occupational and environmental safety and protection system. Development of competences for professional interventions in human resource management (HRM) in organizations in terms of employee protection and occupational and environmental safety. Acquisition of knowledge and skills for efficient action for the purpose of human resource development (HRD) in this field. Development of critical thinking about various aspects of human resource management and development, consideration of possibilities for innovative approaches and actions aimed at improving occupational and environmental safety performance.

Learning outcome

- Possession of a developed knowledge system about modern concepts, strategies, processes, and possibilities of HRM that are necessary for identifying the current state of human resources in an organization, preparing the measures for improving safety performance, and hiring human resources in a way that improves safety culture and develops humane and motivating work conditions;
- Developed competences – knowledge and skills for efficient HRD;
- Understanding and consideration of all stages of HRM directly associated with the processes of occupational and environmental safety, which will enable the accomplishment of strategic business and safety goals.

Course outline

Theoretical lessons

Human resource management: Historical development, term, subject matter, aims, activities, factors, and challenges. HRM as a phase of the management process. **Strategic human resource management:** term, aims, strategy formulation, strategy types, application, and control. **Work analysis and design** (of risks, hazards, and harms), work redesign and redesigning techniques (in terms of occupational and environmental safety). **Human resource planning:** term, characteristics, aims, activities. **Staffing**: term, aim, factors, recruitment process, external and internal sources. **Candidate selection**: Term, aims, significance. Individual differences between candidates. Selection process. Methods and instruments. Evaluation of the selection process. **Human resource development** – employee socialization and orientation. **Career development**: term, characteristics, significance, planning, phases, career anchors, career management. **Training and development**: organizational learning, knowledge management, andragogical cycle, process, phases, traditional and modern approaches. **Evaluation of work success:** term, aims, subject, functions, process, methods, quality evaluation. **Employee awards and motivation**: significance, aims, motivation, incentives, awards. **Particularities of human resource management and development** for occupational safety and health, for environmental protection and sustainable development, for protection against fires, disasters, and other emergencies. **Global changes in the occupational and natural environment and human resource management in the future**: changes, challenges, HRM in the future.

Practical lessons

Auditory exercises, which follow the theoretical lessons and include the presentation and

defence of term papers, which pertain to the current issues of HRM and HRD in terms of occupational and environmental safety (especially environmental protection). Analysis of innovative approaches and case studies of HRM using the examples of different work organizations in the national and international economic context.

Literature

[1.] Nikolić Vesna (2019.) *Menadžment ljudskih resursa – interni materijal za pripremu ispita.* Niš: Univerzitet u Nišu, Fakultet zaštite na radu u Nišu.

[2.] Galjak Mirjana, Nikolić Vesna (2019). *Menadžment u zaštiti.* Leposavić: Visoka tehnička škola strukovnih studija.

[3.] Nikolić Vesna, Anđelković Branislav (2018). *Sistem bezbednosti i zaštite & Razvoj ljudskih resursa i upravljanje znanjem,* (određ. poglavlja). Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

[4.] Nikolić Vesna, Živković Nenad (2017). *Bezbednost radne i životne sredine, vanredne situacije i obrazovanje,* (određ. poglavlja). Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

[5.] Nikolić Vesna (2012). *Tendencije upravljanja i razvoja ljudskih resursa u budućnosti,* u: Upravljanje ljudskim resursima i sigurnost. Zagreb: Visoka škola za sigurnost.

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods

Lectures, conversation and discussions, demonstrations, case studies, office hours

Grading (maximum number of points: 100)

Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Oral exam (theoretical part of the exam)	40
Activity during exercises	5		
Colloquium 1	15		
Colloquium 2	15		
Term paper	20		

Course name: Local Sustainable Development		
Course status: Elective	**Course code:**	19.MMZS12
ECTS credits: 5		
Requirements: -		

Course aim

Enabling students to analyze existing strategic and planning documents at the central and local level, to create and implement a strategy of local sustainable development and related strategic and planning development documents at the local level, and to facilitate strategic planning at the local level.

Learning outcome

Students' ability to:

- facilitate the process of participative planning in cities and municipalities;
- participate in the devising of local strategies of sustainable development, either individually or in a team;
- participate in the creation of development and planning documentation at the local level;
- manage development projects locally;
- monitor local implementation of strategic development documents.

Course outline

Theoretical lessons

Urban systems: Location theory and central place theory. Evolution of urban systems. Primate cities and centrality of cities. Urbanization in socialist and post-socialist societies. European urban system. **Term and definition of local sustainable development:** Sustainable urban development. Spatial planning and urban metabolism. Sustainable rural development. Polycentric development and relationship between urban and rural development. EU policies affecting spatial planning (competition policy, trans-European network policy, environmental policy, research and technological development policy). **Management of local communities:** Decentralization. Decentralization models. Local community management in Serbia. Constitutional and legal foundation. Functions and authority of local self-government. Structure and territorial foundation of local self-government. Fiscal system and financing of local self-government. **Policies and programmes of local sustainable development. Planning of local sustainable development**: Partnership. Stakeholders. Strategic and action planning of local sustainability. Tools for strategic planning of local sustainable development.

Practical lessons

Debate – showing of the film *Urbanized* and discussion about urbanization. Case studies: Hammarby Sjöstad, Niš, Ada, Venice, Budapest, Freiburg. Seminar: Urban mobility (case studies: Barcelona, London, Rome, Stockholm, Berlin). Analysis of local sustainable development strategies in Serbia.

Literature

[1] Milutinović Slobodan (2004). *Urbanizacija i održivi razvoj.* Niš: Univerzitet u Nišu, Fakultet zaštite na radu.

[2] Milutinović Slobodan (2004). *Lokalna Agenda 21: Uvod u planiranje održivog razvoja.* Beograd: Stalna konferencija gradova i opština.

[3] Zlokapa Zdravko, Damjanović Dušan (ur.) (2008). *Modeli organizacije lokalne samouprave.* Beograd: PALGO Centar.

[4] Geiger Zeman Marija, Zeman Zdenko (2010). *Uvod u sociologiju (održivih) zajednica.* Zagreb: Institut društvenih znanosti Ivo Pilar.

[5] Milutinović Slobodan (ur.) (2006). *Priručnik za razvoj vizije opštine u procesima strateškog planiranja održivog razvoja u Srbiji.* Beograd: Stalna konferencija gradova i opština.

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods

Lectures, case studies, debates, seminars

Grading (maximum number of points: 100)

Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Oral exam (theoretical part of the exam)	40
Activity during exercises	5		
Colloquium	30		
Term paper 1	10		
Term paper 2	10		

Course name: Environmental Policy		
Course status: Elective	**Course code:**	19.MMZS07
ECTS credits: 6		
Requirements: -		

Course aim

Acquisition of basic theoretical and practical knowledge about environmental policy with simultaneous development of critical thinking and acquisition of practical skills to participate in the decision making regarding practical policies that concern the issues of social development and that can have a positive relation and attitude towards the environment.

Learning outcome

Students' ability to:

- thoroughly understand theoretical concepts of environmental policy;
- stay up to date with and utilize any new developments regarding environmental policy and share that knowledge with others;
- analyze the existing practical policies and environmental policy;
- participate in the formulation and making of strategic decisions and decisions regarding practical policies, which are aimed towards resolving specific environmental issues in the country and in the local environment.

Course outline

Theoretical lessons

Policy and ethics. Ethical theories (divine origin theory, virtue theory, utilitarianism, deontological ethics). Ethical perspectives of environmental protection (anthropocentrism, biocentrism, ecocentrism, deep ecology). Relationship between ethics and environmental policy (reformative approach to environmental ethics, radical approach to environmental ethics, environmental pragmatism, question of legitimacy, question of sovereignty). **Modern political theories** (Origin and development of political theories. Liberalism, social democracy, socialism, conservativism. Relation of political theories towards environmental protection). **Formation and historical development of environmental policy.** Environmental policy prior to 1992. Environmental policy after 1992. **Common good theory.** Public goods and common interest. Types of goods. Particularities of public goods. Externalities. Positive and negative externalities. Positional goods and externalities in consumption. International environmental policy. Principles of international environmental policy. Mechanisms and tools: multilateral agreements. **National environmental policy instruments.** Planning instruments. Legal instruments. Economic instruments. Instruments for impact assessment. Instruments for monitoring and evaluation. **Environmental protection and conflicts. Environmental policy changes after the RIO+20 conference.**

Practical lessons

Case study: Water shortage in the Middle East. Case study: Impact of coal mining in the Ústí nad Labem Region on environmental policy. Case study: Extraction of mineral raw materials or conservation in New Zealand. Debate: Use of multilateral agreements in environmental protection – advantages and disadvantages. Seminar: Analysis of the EU pre-accession position of Serbia regarding Chapter 27 – Environment and Climate Change (analysis of the Post-Screening Document). Writing and defence of term papers.

Literature

[1.] Milutinović Slobodan (2012). *Politike održivog razvoja*. Niš: Fakultet zaštite na radu

[2.] Andrej Steiner, Henrieta Martonakova, Zuzana Guziova (ur.) (2003). *Vodič za dobro upravljanje u oblasti životne sredine*. Beograd: UNDP

[3.] Timothy Doyle, Doug McEachern (2008). *Environment and Politics*. Third Edition. London: Routledge
[4.] Steven Cohen (2006). *Understanding Environmental Policy*. New York: Columbia University Press

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods

Lectures (including presentations and debates), exercises (term papers, case studies), and office hours

Grading (maximum number of points: 100)

Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Oral exam (theoretical part of the exam)	40
Activity during exercises	5		
Colloquium	30		
Term paper 1	10		
Term paper 2	10		

Course name: Social Ecology		
Course status: Elective	**Course code:**	19.MZZS10
ECTS credits: 5		
Requirements: -		

Course aim

Familiarizing students with socioecological interpretations of the relation between nature and society in order for them to accept the holistic world view and the principles of ecological ethics and in turn properly perceive the environmental impact of social development, all so that they, as managers, can fully contribute to the solution of environmental issues, provision of more humane living conditions, and actualization of sustainable development.

Learning outcome

Students' ability to:

- understand the social causality of ecological issues and ecological crisis;
- accept the ecological-ethics principles and act accordingly;
- accept the fact that there is no permanent and substantial solution of environmental issues without the acknowledgment of social factors operating within the environment;
- understand the institutional forms and their mechanisms that contribute to the harmonization of society's developmental needs and environmental capacities;
- participate in the creation of strategic documents about the actualization of sustainable development on a local, regional, and global level.

Course outline

Theoretical lessons

Subject matter of social ecology: Ecology as a science. Basic ecological terms. Humans as natural and social beings. Human environment (definition and elements of human environment, relations between elements of human environment, relation between the work and the natural environment). **Quality of life:** Definition of quality of life. Environmental quality as an element of quality of life. **Ecological crisis:** Definition of ecological crisis. Social aspects of the ecological crisis of modern society: pollution of nature, pollution of the work environment (occupational alienation and technical risks), pollution of the social environment (alienation from life and society, consumer culture, false values). Social causes of ecological crisis: technological development, urban sprawl, industrialization, nature of the economic and social system, population growth, system of values, consumption, globalization. **Different views of the nature-society relation:** Reflections on the nature-society relation before the 1970s; ideas about solving ecological issues put forward by the members of the Club of Rome in the following publications: The Limits to Growth, Mankind at the Turning Point, RIO – Reshaping the International Order, Goals for Mankind, Beyond the Age of Waste, Beyond the Limits: Global Collapse or a Sustainable Future, 2052 – A global Forecast for the Next Forty Years. **Ecological awareness, ethics, and culture:** Definition and elements of ecological awareness. Importance of ecological awareness for the harmonization of relations between society and nature. Philosophical and social bases of the development of ecological ethics. Influence of religion, tradition, and other factors on the shaping of ecological ethics. **Anthropocentrism:** strong and weak anthropocentrism. **Ecocentrism:** animal ethics, bio ethics, and geoethics. **Socioecological theories:** deep ecology, ecofeminism, eco-anarchism, eco-liberalism, eco-socialism. **Ecological culture and solution of ecological problems:** Definition of culture. Pre-industrial culture and environment, industrial culture and environment, post-industrial – ecological – culture

and environment. Film and environmental protection. Music and environmental protection. **Ecological politics:** Definition of ecological politics. Traditional and ecological politics. Principles, goals, and subjects of ecological politics. **Ecological movements and ecological parties:** Definition of new social movements. Ecological movements and their importance for the solution of ecological issues. Ecological parties and green ideology. **Globalization and ecology:** Global society as a society of manufactured risks. Globalization and ecological inequality in the world.

Practical lessons

Auditory exercises: discussions based on analyses of texts, statistical data, and presented video materials depicting causes and effects of ecological crisis, ecological challenges of the modern world, environmental activism, environmental migrants, ecological discourse, acceptance of ecological-ethics principles, and level of development of ecological awareness; defence of term papers.

Literature

[1.] Marković Ž. Danilo (2015). *Socijalna ekologija*. Beograd: Zavod za udžbenike i nastavna sredstva

[2.] Miltojević D. Vesna (2005). *Ekološka kultura*. Niš: Univerzitet u Nišu, Fakultet zaštite na radu

[3.] Ilić Krstić Ivana (2018). *Ekološka bezbednost u pograničju-studija slučaja*. Novi Sad: Prometej; Niš; Mašinski fakultet: JUNIR

[4.] Nadić Darko (2012). *Ogledi iz političke ekologije*. Beograd, Čigoja štampa i Fakultet političkih nauka Univerziteta u Beogradu

[5.] Hannigan John (2014). *Environmental Sociology*. London and New York: Routledge

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods

Lectures, presentations, discussion, term papers, office hours, individual and group work

Grading (maximum number of points: 100)

Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Oral exam (theoretical part of the exam)	40
Activity during exercises	5		
Colloquium 1	15		
Colloquium 2	15		
Term paper	20		

Course name: Environmental Management

Course status: Elective	**Course code:** 19.MZZS11

ECTS credits: 6

Requirements: -

Course aim

Acquisition of knowledge about the term, purpose, and goals of environmental management.

Learning outcome

Students' ability to:

- understand the concept of environmental management and be equipped to preserve and improve the environment;
- implement concrete actions and procedures towards environmental protection;
- purposefully implement regulations and procedures according to the model of management system included in the ISO 14000 series of standards.

Course outline

Theoretical lessons

Management: Definition of management. Basic functions of management (planning, organization, human resource management, governance, and control). Classification of management processes. Role and task of managers. Characteristics, knowledge, and capabilities of managers. **Definition, purpose, and goals of environmental management**: Basic types of environmental management. Principles of environmental protection. Principles of environmental management. **Environmental management systems at the national level**: Subjects of environmental management. Competence of local self-governments in the field of environmental protection. Place and role of civil society organizations in the environmental protection system. **Strategic environmental impact assessment:** Conditions, method, and procedures for strategic assessment of the environmental impact of specific plans and programmes. Strategic assessment of the environmental impact of specific plans and programmes. Basic principles of strategic assessment; strategic assessment report. Strategic assessment procedure. **Environmental management:** Environmental management as a business process. Use of ICT in environmental management systems. Environmental management systems according to international regulations. Model of management system according to the ISO 14000 series of standards. Risk management in compliance with ISO 31000:2009. Environmental management system using the business intelligence model.

Practical lessons

Auditory exercises, which follow the theoretical lessons. Presentation and defence of term papers on a topic pertaining to environmental management.

Literature

[1.] Živković Snežana (2015). *Upravljanje zaštitom životne sredine* (skripta). Niš: Univerzitet u Nišu, Fakultet zaštite na radu

[2.] Črnjar Mladen, Črnjar Kristina, Perić Jože, Zelenika Ratko, Denona-Bogović Nada (2009). *Menadžment održivog razvoja: ekonomija, ekologija, zaštita okoliša*. Opatija: Fakultet za menadžement u turizmu i ugostiteljstvu

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods

Lectures, exercises (including the term paper), discussions, office hours

Grading (maximum number of points: 100)			
Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Oral exam (theoretical part of the exam)	40
Activity during exercises	5		
Colloquium 1	15		
Colloquium 2	15		
Term paper 1	20		

Course name: Information Systems in Safety

Course status: Elective	**Course code:**	19.MZNR13

ECTS credits: 5

Requirements: -

Course aim

Acquisition of knowledge about information systems and networks and their application in the domain of safety.

Learning outcome

Knowledge about organization, types, and application of information systems and information and communication networks in safety engineering. Students' ability to:

- understand the principles and concepts of information systems;
- understand how computer networks and general-purpose networks work;
- use available online services and content.

Course outline

Theoretical lessons

Definition and fundamental concepts of information systems: Definition, functions, and components of information systems. Fundamental concepts of information systems. Application areas of information systems. Application of information systems. **Data**: Data acquisition and storage. Memory technologies. Databases, data models, and program tools. **Networks**: Communication transfer technologies. Types of computer networks. Characteristics of computer networks. Layered architecture of communication networks. OSI reference model. Computer network topologies. Sharing of hardware and software resources. Telecommunication systems. Communication links. Local networks. Wireless technologies. Location services. Network hardware components. Routing. Protocols. Network addressing. **Online services**: URL addresses. Web services. Web applications. Content management systems. Interactive Internet services. Data search. Geographic information systems. Sensor networks. Compromised services of information systems.

Practical lessons

Auditory and calculation exercises, which follow the theoretical lessons. Analysis of information and communication technology, consideration of various applications of information systems, and analysis of practical examples from occupational safety, all of which stimulates research and use of information systems in engineering practice.

Literature

[1.] Tanenbaum Andrew, Wetherall David (2013). *Računarske mreže* (5. izdanje). Beograd: Mikroknjiga

[2.] Seen James (2011). *Informaciona tehnologija – principi, praksa, mogućnosti*. Beograd: Kompjuter biblioteka

[3.] Rainer Kelly, Turban Efraim (2009). *Uvod u informacione sisteme*. Beograd: Mikroknjiga

[4.] Shay William (2004). *Savremene komunikacione tehnologije i mreže*. Čačak: Kompjuter biblioteka

Number of active classes (weekly)

Lectures	2	Auditory exercises	1	Other forms of classes	0.53	CIR	-	Other classes	-

Teaching methods

Lectures, auditory (calculation) exercises, and office hours. Interactive work with students.

Grading (maximum number of points: 100)			
Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Oral exam (theoretical part of the exam)	40
Activity during exercises	5		
Colloquium 1	25		
Colloquium 2	25		

Course name: Systems Engineering

Course status: Elective	**Course code:** 19.MZNR14

ECTS credits: 5

Requirements: -

Course aim

Acquisition of knowledge about fundamental characteristics, processes, and disciplines of systems engineering and about models and methods of decision making and effectiveness assessment.

Learning outcome

Students' ability to:

- connect engineering and managerial demands in order to analyze and solve safety problems;
- develop and apply methods and procedures for the assessment of safety system effectiveness;
- analyze systems using the systems engineering approach to improve performance;
- participate in team-work and decision-making.

Course outline

Theoretical lessons

Introduction to systems engineering: Definition, elements, and processes of systems engineering. Systems analysis. System lifecycle. **Systems engineering process**: Identification of requirements, operational requirements, and requirements of the surrounding. Identification of performance measures. Functional analysis and allocation of requirements. Optimization. Risk in the systems engineering process. System specification. Models and tools for system description. Basic disciplines of systems engineering. **Systems engineering management**: Planning and organization of processes of systems engineering. Standardization of the systems engineering process. Program support. **Team-work and decision making:** Assessment of team-work effectiveness. Program support for effective application of the principles of systems engineering in an integrated team surrounding. Models and methods for assessing system effectiveness. Multiple-criteria analysis methods (ELECTRE, PROMETHEE, AHP). Hierarchical organization and ranking of key performance indicators.

Practical lessons

Auditory and calculation exercises, which follow the theoretical lessons. Consideration of the use of systems engineering methods for system specification and analysis of practical examples. Defence of term papers dealing with occupational safety, which stimulates research and practical application of the methods considered.

Literature

[1.] Walden David, Roedler Garry, Fosberg Kevin, Hamelin Douglas, Shortell Thomas (2015). *INCOSE Systems engineering handbook: a guide for system life cycle processes and activities,* 4th Edition. New Jersey: John Wiley & Sons

[2.] Blanchard Benjamin (2004). *System engineering management*. New Jersey: John Wiley & Sons, Inc.

[3.] Papić Ljubiša, Milovanović Zdravko (2007). *Održavanje i pouzdanost tehničkih sistema*. Prijevor: DQM

[4.] Čupić Milutin, Suknović Milija (2010). *Odlučivanje*. Beograd: Univerzitet u Beogradu, Fakultet organizacionih nauka

Number of active classes (weekly)

Lectures	2	Auditory exercises	2	Other forms of classes	-	RS	-	Other classes	-

Teaching methods Lectures, auditory (calculation) exercises, office hours. Interactive work with students.			
Grading (maximum number of points: 100)			
Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Written exam (practical part of the exam)	40
Activity during exercises	5		
Colloquium	20		
Term paper	30		

Course name: Project Management		
Course status: Elective	**Course code:**	19.MZNR16
ECTS credits: 5		
Requirements: -		

Course aim

Acquiring knowledge about the concept, methods, techniques, and application of project management principles in preventive engineering and other related (organizational and technical) disciplines.

Learning outcome

Students should be able to:

- plan and monitor projects;
- organize project activities;
- apply modern software tools for project management;
- apply the project management concept in planning and implementation of various occupational and environmental safety related projects.

Course outline

Theoretical lessons

Introduction to project management: Development and importance, of the concept. Areas of application. Certification bodies. **Basic characteristics of a project:** Definition, framework/scope, project goals, "triple constraint". Planning, identification and selection of resources. Critical factors. Project integration. Process groups and project lifecycle. **Project planning and monitoring:** SWOT analysis, SMART goals, Logical framework matrix (*LFM*). **Project management methods and techniques:** Gantt charts, WBS-PBS–OBS diagrams, network planning. **Network diagrams:** rules for drawing and numbering network diagrams, time analysis, critical path method (*CPM*). **Organization of project management:** Project quality management. Managing scope, time, and costs, project progress evaluation. Project risk management. Project implementation, monitoring and control. **Software tools for project management:** overview of relevant software packages, introduction to *MS Project*.

Practical lessons

Audio-visual exercises that follow the theoretical lessons, calculation exercises (applying CPM method: creation of a network diagram structure, event numbering, progressive and regressive time calculation, identification of critical path within a network diagram), application of project management software tools (MS Project), presentation and defence of a project assignment on a topic from the course syllabus.

Literature

[6.] Jovanović Predrag (2005). *Upravljanje projektom*. Univerzitet u Beogradu, Beograd: Fakultet organizacionih nauka.

[7.] Stanimirović Predrag (2009). *Mrežno planiranje i MS PROJECT*. Univerzitet u Nišu, Niš: Prirodno matematički fakultet.

[8.] Glisovic Srdjan (2018). *Environmental Life Cycle Management as a Framework for Successful Project Development, Management and Safety*. The European Society of Safety Engineers.

[9.] Petronijević Predrag (2006). *Brzi vodič kroz MS PROJECT*. Univerzitet u Beogradu, Građevinsko-arhitektonski fakultet.

[10.] Project Management Institute (2013). *A Guide to the Project Management Body of Knowledge*, Fifth Edition (*PMBOK Guide*). Newtown Square, PE: Project Management Institute.

Number of active classes (weekly)									
Lectures	2	Auditory exercises	1	Other forms of classes	0.53	RS	-	Other classes	-

Teaching methods
Lectures, exercises, office hours. Term paper defence.

Grading (maximum number of points: 100)

Pre-exam requirements	Points	**Exam**	Points
Activity during lectures	5	Written exam (practical part of the exam)	25
Activity during exercises	5	Oral exam (theoretical part of the exam)	15
Colloquium 1	15		
Colloquium 2	20		
Term paper	15		