STUDY PROGRAM PROPOSAL

Professional Undergraduate Study Program in Mechatronics

Bjelovar, February 2024

List of compulsory and elective courses along with the corresponding ECTS points, forms of delivery, course content, planned learning outcomes and lead course instructors

COURSE DESCRIPTION						
Year of study: 1st						
Semester: 1st						
COURSE	**DIRECTOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Mathematics 1	Ivana Marušić, senior lecturer	30	30	0	5	Compulsory
Fundamentals of Engineering Calculations	Ivana Marušić, senior lecturer	0	30	0	2	Compulsory
Fundamentals of Electrical Engineering	Goran Benkek, lecturer	30	45	0	6	Compulsory
Sensors	Slavko Majstorović, lecturer	30	30	0	5	Compulsory
Technical documentation of a Mechatronic System	Tomislav Pavlic, PhD, professional study program professor	30	30	0	5	Compulsory
Fundamentals of the Programming Language Python	Ivan Sekovanić, senior lecturer	15	30	0	4	Compulsory
Communication Skills	Tatjana Badrov, MSc, senior lecturer	15	30	0	3	Compulsory
Semester: 2nd						
Mathematics 2	Ivana Marušić, senior lecturer	30	45	0	5	Compulsory
Fundamentals of Mechanics 1	Tomislav Pavlic, PhD, professional study program professor	30	45	0	6	Compulsory
Virtual Modeling and Simulation	Tomislav Pavlic, PhD, professional study program professor	20	40	0	5	Compulsory
Electronic Components and Assemblies	Goran Benkek, lecturer	30	30	0	5	Compulsory
Fundamentals of the Programming Language C	Krunoslav Husak, senior lecturer	30	30	0	5	Compulsory
Application of Tools in Office Management	Dario Vidić, adjunct senior lecturer	15	30	0	4	Compulsory

COURSE DESCRIPTION						
Year of study: 2nd						
Semester: 3rd						
COURSE	**DIRECTOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Fundamentals of Mechanics 2	Tomislav Pavlic, PhD, professional study program professor	30	45	0	6	Compulsory
Fundamentals of Digital Logic	Dario Vidić, adjunct senior lecturer	30	30	0	6	Compulsory
Electromechanical and Electronic Converters	Goran Benkek, lecturer	20	25	0	4	Compulsory
Additive Technologies	Tomislav Pavlic, PhD, professional study program professor	15	30	0	4	Compulsory
Machine Elements	Tomislav Pavlic, PhD, professional study program professor	15	25	0	3	Compulsory
Fundamentals of Signals and Systems	Zoran Vrhovski, PhD, professional study program professor	15	20	0	3	Compulsory
Technical English	Ivana Jurković, senior lecturer	30	30	0	4	Compulsory
Semester: 4th						
Automated controls	Zoran Vrhovski, PhD, professional study program professor	30	30	0	6	Compulsory
Microcontrollers	Zoran Vrhovski, PhD, professional study program professor	15	40	0	5	Compulsory
Fundamentals of Mechanisms	Tomislav Pavlic, PhD, professional study program professor	15	30	0	4	Compulsory
Maintenance of Mechatronic Systems	Stjepan Golubić, PhD, adjunct professional study program professor	30	15	0	4	Compulsory
Quality Management	Stjepan Golubić, PhD, adjunct professional study program professor	15	15	0	3	Compulsory
Business Planning	Adela Zobundžija, adjunct lecturer	15	15	15	4	Compulsory
Business English	Ivana Jurković, senior lecturer	30	30	0	4	Compulsory

LIST OF COURSES						
Year of study: 3rd						
Semester: 5th						
COURSE	**DIRECTOR**	**L**	**E**	**S**	**ECTS**	**STATUS**
Automation Fundamentals	Zoran Vrhovski, PhD, professional study program professor	30	30	0	6	Compulsory
Pneumatics and Hydraulics	Tomislav Pavlic, PhD, professional study program professor	30	30	0	5	Compulsory
Applied Robotics	Tomislav Pavlic, PhD, professional study program professor	30	30	0	5	Compulsory
Internet of Things (IoT)	Dario Vidić, adjunct senior lecturer	15	45	0	5	Compulsory
Project	Zoran Vrhovski, PhD, professional study program professor Tomislav Pavlic, PhD, professional study program professor Goran Benkek, lecturer	0	0	0	5	Compulsory
Fundamentals of Entrepreneurship	Adela Zobundžija, adjunct lecturer	30	15	0	4	Elective
Introduction to Artificial Intelligence	Krešimir Markota, lecturer	15	30	0	4	Elective
Design and Production of Electronic Devices	Goran Benkek, lecturer	15	30	0	4	Elective
Semester: 6th						
Technical Materials and Production Processes	Stjepan Golubić, PhD, adjunct professional study program professor	45	30	0	6	Compulsory
Professional practice	Goran Benkek, lecturer	0	0	10	6	Compulsory
Final thesis	-	0	0	0	10	Compulsory
Computer Vision	Ante Javor, adjunct lecturer	20	25	0	4	Elective
Automation of Machines and Devices	Zoran Vrhovski, PhD, professional study program professor	15	30	0	4	Elective
Designing Photovoltaic Systems	Elizabeth Hedl, adjunct lecturer	15	30	0	4	Elective

* the student selects 1 elective course in the 5th semester
** the student selects 2 elective courses in the 6th semester

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Ivana Marušić, senior lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Mathematics 1</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td>1st</td><td colspan="2">Semester</td><td colspan="4">1st</td></tr>
<tr><td rowspan="2">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="6">5</td></tr>
<tr><td colspan="2">Classes total (L+E+S)*</td><td colspan="2">30 + 30 + 0</td><td>L</td><td colspan="2">E</td><td>S</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>30</td><td>AE
30</td><td>LE</td><td></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The aim of the course is to master functions of real variables, series, sequences, linear algebra and basics of vector space with application to linear operators in the plane and space.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="5">ULO1</td><td rowspan="5">Functions of a real variable, sequences and series</td><td>O1</td><td colspan="5">Describe elementary real functions of a real variable, enumerate their properties and sketch their graphs.</td></tr>
<tr><td>O2</td><td colspan="5">Use elementary functions and their properties when solving simple real problems.</td></tr>
<tr><td>O3</td><td colspan="5">Solve a mathematical problem in the area of strings, limes of strings and lines.</td></tr>
<tr><td>O4</td><td colspan="5">Apply sequences and lines in solving problems from the field of application.</td></tr>
<tr><td>O5</td><td colspan="5">Apply limes functions in testing the continuity of a function.</td></tr>
<tr><td rowspan="2">ULO2</td><td rowspan="2">Introduction to linear algebra.</td><td>O6</td><td colspan="5">Perform basic operations on matrices and vectors and apply matrix and vector calculus in solving systems of linear equations.</td></tr>
<tr><td>O7</td><td colspan="5">Calculate determinants and apply properties of determinants in solving linear algebra problems.</td></tr>
<tr><td rowspan="2">ULO3</td><td rowspan="2">Fundamentals of vector spaces with application to linear operators in the plane and space</td><td>O8</td><td colspan="5">Define a vector space and give examples of vector spaces or objects in vector spaces.</td></tr>
<tr><td>O9</td><td colspan="5">Define a linear operator and apply linear operators to operations of transformations in the plane and in space.</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Sets (Outcome O1)
The term "set". A subset. The equality of sets. Cardinal number of the set. Operations with sets.</td></tr>
</table>

2. Functions of the real variable (Outcome O1, O2)
The concept of function. Equality of functions. Method of assigning a function. Properties of functions. Elementary functions, their properties and graphs. Composition of functions. Inverse function and domain of definition. Arc function.
3. Strings and rows (Outcome O3, O4)
The concept of an array. Arithmetic sequence. Geometric series. String properties. Rows. Limes of sequence and order. Some important limes.
4. Limit value and continuity of the function (Outcome O5)
Limes functions. The limit value of the function. Continuity of function. Asymptotes.
5. Linear algebra (Outcome O6, O7)
Definition and special forms of matrices. Basic operations with matrices. Matrix polynomial. Multiplication of matrices. Commutativity of matrices. System of linear equations. Matrix rank. Determinant of the matrix. Determinant properties. Sarrus' rule. Laplace development of the nth order determinant. Regular matrix. Calculation of the inverse matrix using the Gauss-Jordan method. Calculating the inverse matrix using the determinant. Cramer's rule. Matrix equation.
6. Vector algebra (Outcome O8, O9)
Coordinate system in space. Scalar product. Vector product. Linear combination of vectors. Area and height of a triangle. Area of a parallelogram. Mixed product. Volume and height of a parallelepiped. The volume of the tetrahedron.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☒ multimedia and network ☐ laboratory ☐ mentor work ☐ other:

Students' obligations

- Attending lectures and exercises according to the Study Regulations.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Mid-term exam 3	Threshold	Max
ULO1	O1	10%			5%	**10%**
	O2	10%			5%	**10%**
	O3	8%			4%	**8%**
	O4	6%			3%	**6%**

	O5	6%			3%	**6%**
ULO2	O6		20%		10%	**20%**
	O7		20%		10%	**20%**
ULO3	O8			10%	5%	**10%**
	O9			10%	5%	**10%**
	Total	**40%**	**40%**	**20%**	**50%**	**100%**

The student passed the course if he achieved a percentage of points that is greater than or equal to the defined Threshold on each learning outcome. Points earned on the passed Learning Outcomes are deleted one year after the beginning of the semester in which the course is taught. Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period.

Exam term:

ULO	Outcomes	Written exam	Threshold	Max
ULO1	O1	10%	5%	**10%**
	O2	10%	5%	**10%**
	O3	8%	4%	**8%**
	O4	6%	3%	**6%**
	O5	6%	3%	**6%**
ULO2	O6	20%	10%	**20%**
	O7	20%	10%	**20%**
ULO3	O8	10%	5%	**10%**
	O9	10%	5%	**10%**
	Total	**100%**	**50%**	**100%**

The student passed the course if he achieved a percentage of points that is greater than or equal to the defined Threshold on each learning outcome. Points earned on the passed Learning Outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students

Tomić, Milorad: Mathematics 1, Technical College in Bjelovar, Bjelovar, 2009.	9	30
Marušić, Ivana: "Presentation of lectures and exercises – Mathematics 1", the Bjelovar University of Applied Sciences	online	30
Supplementary reading materials:		
Tomić, Milorad: Mathematics 2, Technical College in Bjelovar, Bjelovar, 2009. Pavlovič Demidović, Boris, and others: "Tasks and solved examples from Mathematical analysis for technical faculties", Golden marketing, Tehnička knjiga, Zagreb, 2003.		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators analyzing the students' studies, passing of exams, employment rates of graduates and other quality indicators. Regular updating and modernizing of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Ivana Marušić, senior lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Fundamentals of Engineering Calculations</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td>1st</td><td colspan="2">Semester</td><td colspan="4">1st</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="6">2</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">0 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td></td><td>30</td><td></td><td></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The goal of the course is to create equal prerequisites for students to study more mathematics.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="5">ULO1</td><td rowspan="5">Fundamentals of engineering calculations</td><td>O1</td><td colspan="5">Calculate the values of complex mathematical expressions or physical laws</td></tr>
<tr><td>O2</td><td colspan="5">Apply elementary mathematics, geometry and trigonometry in engineering calculations</td></tr>
<tr><td>O3</td><td colspan="5">Convert basic and derived physical units</td></tr>
<tr><td>O4</td><td colspan="5">Determine the parameters of the direction using the method of least squares</td></tr>
<tr><td>O5</td><td colspan="5">Interpret function graphs that appear in engineering practice</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Potencies, algebraic expressions, roots (Outcome O1)
Potency application. Application of algebraic expressions. Equations. Functions. Polynomials and rational functions. Roots.
2. Device on the set of real numbers (Outcome O1)
Intervals. Inequalities. The absolute value of a real number.
3. Coordinate system in the plane (Outcome O1)
Distance of points in a plane. Half the length. System of linear equations. Direction. Graph of the function.
4. Geometry (Outcome O1, O2)
Points, lines and planes. Angle. Triangle. Trapeze. An isosceles trapezoid. Parallelogram. Rhombus. A rectangle. Square. Roundabout. Lap. Volume and area.
5. Trigonometry (Outcome O1, O2)</td></tr>
</table>

Trigonometry of a right triangle. Definitions of trigonometric functions. Properties of trigonometric functions. Application of trigonometric functions.

6. Calculation of complex mathematical expressions and physical laws (O2)

7. Physical quantities and units (Outcome O3)

Basic SI units. Complementary SI units. Derived SI units with a special name. Allowed units outside SI. SI unit prefixes. Conversion of physical units.

8. Method of least squares (Outcome 4)

9. Interpret function graphs that appear in engineering practice (Outcome O5)

Teaching formats	☐ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☒ multimedia and network ☐ laboratory ☐ mentor work ☐ other:

Students' obligations

- Attending auditory exercises according to the Study Regulations.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment		Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam	Threshold	Max
ULO1	O1	26%	13%	**26%**
	O2	26%	13%	**26%**
	O3	16%	8%	**16%**
	O4	16%	8%	**16%**
	O5	16%	8%	**16%**
	Total	**100%**	**50%**	**100%**

The student passed the course if he achieved a percentage of points that is greater than or equal to the defined Threshold on each learning outcome. Points earned on the passed Learning Outcomes are deleted one year after the beginning of the semester in which the course is taught. Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period.

Exam term:

ULO	Outcomes	Mid-term exam	Threshold	Max
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	O4	16%	8%	**16%**
	O5	16%	8%	**16%**
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75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Pisačić, Katarina: "Basics of engineering budgeting", University North, Varaždin, 2014, available at: http://unin.hr/~kpisacic/PA1_vjezbe.pdf	online	30
Marušić, Ivana: "Basics of engineering budgeting", the Bjelovar University of Applied Sciences, Bjelovar, 2021. Available at the Merlin e-learning system.	online	30

Supplementary reading materials:

Bronštejn, Ilja Nikolajevič; Semendjajev, Konstantin Adolfovič: "Mathematical handbook for engineers and students", Tehnička knjiga, Zagreb, 1964.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators analyzing the students' studies, passing of exams, employment rates of graduates and other quality indicators.
Regular updating and modernizing of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td colspan="2">Lead instructor</td><td colspan="6">Goran Benkek, lecturer</td></tr>
<tr><td colspan="2">Course name</td><td colspan="6">Fundamentals of Electrical Engineering</td></tr>
<tr><td colspan="2">Study program</td><td colspan="6">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td colspan="2">Course status</td><td colspan="6">Compulsory</td></tr>
<tr><td colspan="2">Year</td><td colspan="2">1st</td><td>Semester</td><td colspan="3">1st</td></tr>
<tr><td colspan="2" rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">6</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">30 + 45 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>30</td><td>30</td><td>15</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquaint students with the analysis of basic electromagnetic phenomena and electric circuits and solving electrical engineering problems based on direct, alternating and three-phase circuits.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="3">Unit of learning outcomes</td><td colspan="5">Learning outcomes</td></tr>
<tr><td rowspan="5">ULO1</td><td colspan="2" rowspan="5">Fundamentals of electrostatics and direct current electric circuits</td><td>O1</td><td colspan="4">Analyze basic electrostatic phenomena</td></tr>
<tr><td>O2</td><td colspan="4">Calculate current, voltage, power and energy in a simple direct current circuit</td></tr>
<tr><td>O3</td><td colspan="4">Design a simple direct current electrical circuit with basic circuit components</td></tr>
<tr><td>O4</td><td colspan="4">Analyze direct current electrical circuits using basic circuit analysis methods</td></tr>
<tr><td>O5</td><td colspan="4">Analyze transient phenomena in networks consisting of R, L and C elements and DC voltage sources</td></tr>
<tr><td rowspan="5">ULO2</td><td colspan="2" rowspan="5">Fundamentals of electromagnetism and electric circuits of alternating current</td><td>O6</td><td colspan="4">Analyze phenomena from the field of electromagnetism</td></tr>
<tr><td>O7</td><td colspan="4">Calculate current, voltage, power and energy in a simple alternating current electrical circuit</td></tr>
<tr><td>O8</td><td colspan="4">Analyze alternating current circuits using the phasor calculator</td></tr>
<tr><td>O9</td><td colspan="4">Analyze voltages and sources currents in the network consisting of R, L and C elements and AC voltage</td></tr>
<tr><td>O10</td><td colspan="4">Analyze the connections of the three-phase system</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Introduction to electrical engineering (Outcome O1)
The concept of electrical engineering. Basic concepts of electricity. Atom and electric charge.
2. Electric charge and electric field (Outcome O1)</td></tr>
</table>

Coulomb's law. Static electricity. Electric field. Electric dipole. Electrification. Electric potential energy. Work of electric field force. Electric potential. Equipotential surfaces. Voltage in the electric field. Matter in an electric field. Basic about electrical capacity.

3. **Basic terms and elements of circuits** (Outcome O2)

Electrical conductors. Electric current strength, current density, electrical resistance and conductivity. Charge movement. Effects of electric current. Ohm's law. Energy and strength. Utility coefficient. Dependence of resistance on temperature. Resistance connection, series, parallel and mixed connection. Introduction to Kirchhoff's laws.

4. **Designing simple direct current electrical circuits with basic circuit components** (Outcome O3)

Basic elements of circuits and basics of electrical measurements. DC and AC sources. Current and voltage sources.

5. **Direct current circuits and capacitor connections** (Outcome O4)

Concept of electric network, solution methods. Bridge connection, delta and star resistance connection. K.Z. method, contour current method, superposition method, node potential method. Thevenin's theorem. Norton's theorem. Millman's theorem. Connections and types of capacitors. Series, parallel and mixed connection of capacitors. Application of capacitors.

6. **Transitional phenomena** (Outcome 5)

Introduction to transitional phenomena. Commutation laws and initial conditions. RC and RL connections. RLC connections. LC circuit. Electric oscillations.

6. Electromagnetism (Outcome O6)

Magnetic field, magnetic flux, magnetic induction. Lorentz force. Force on a current-carrying conductor, force between two magenta, force between two straight parallel and long current-carrying conductors. Ferromagnetism, diamagnetism, paramagnetism, magnetization curve, hysteresis loop. Electromagnetic induction, Faraday's law. Eddy currents, self-induction and intermediate induction, inductance and intermediate inductance.

7. Alternating current (Outcome O7)

Basic concepts of alternating current, current, effective and mean value, frequency. Ohmic and reactive resistances. Concept of impedance and admittance, phase angle.

8. Complex analysis of AC networks (Outcome O8)

The concept of phasors and operations with phasors. AC power. Compensation of idle energy. Permitted current flow through the body and safety in working with electricity.

9. Series and parallel connection of RLC components (Outcome O9)

Resonance. Voltage and current resonance.

10. Three-phase system and basics of electrical installations (Outcome O10)

Introduction to the multiphase system. Three-phase system. Three-phase system connections: star and delta. Concept of phase and line voltages. Symmetrical load star connection (without and with neutral conductor). Unsymmetrical star load (without and with neutral conductor. Symmetrical load delta connection. Unsymmetrical load delta connection. Three-phase system power. Networks and distribution systems. Introduction to electrical installations and basic components of electrical installations. (Outcome O6)

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☐ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☐ other: flipped classroom
Students' obligations		

- Full-time students must attend 5 out of 7 laboratory exercises.
- Part-time students must attend 4 out of 7 laboratory exercises.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Laboratory exercises	Mid-term exam 1	Mid-term exam 2	Mid-term exam 3	Threshold	Max
ULO1	O1		10 %			5 %	10 %
	O2		5 %			2,5 %	5 %
	O3		5 %			2,5 %	5 %
	O4		10 %			5 %	10 %
	O5			15 %		7.5 %	15 %
ULO2	O6			10 %		5 %	10 %
	O7			5 %		2,5 %	5 %
	O8				10 %	5 %	10 %
	O9				10 %	5 %	10 %
	O10				10 %	5 %	10 %
		10%				5%	10%
	Total	**10%**	**30** %	**30** %	**30** %	**50 %**	**100 %**

The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined passing threshold on each learning outcome of which course is taught. Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught. During laboratory exercises, students write short tests in which it is necessary to collect a number of points that is greater than or equal to the defined threshold.

Exam term:

ULO	Outcomes	Report from laboratory exercises	Written exam	Threshold	Max
ULO1	O1		10 %	5 %	10 %
	O2		5 %	2,5 %	5 %
	O3		5 %	2,5 %	5 %
	O4		10 %	5 %	10 %
	O5		15 %	7.5 %	15 %
ULO2	O6		10 %	5 %	10 %
	O7		5 %	2,5 %	5 %

	O8		10 %	5 %	10 %
	O9		10 %	5 %	10 %
	O10		10 %	5 %	10 %
		10%		5%	10%
	Total		**90 %**	**50 %**	**100 %**

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Kuzmanović, Branislav: Basics of electrical engineering 1, Zagreb, Element, 2012.	20	30
Kuzmanović, Branislav: Basics of electrical engineering 2, Zagreb, Element, 2017.	10	30
Elizabeth Hedl: Lecture presentations from Fundamentals of Electrical Engineering, the Bjelovar University of Applied Sciences, available on the e-learning system Merlin	online	30

Supplementary reading materials:

Stanić, Eugen: Basics of Electrical Engineering, Zagreb, Školska knjiga, 2007.
Malešević, Ljubomir: Basics of Electrical Engineering II, Split, Study of electronics and power engineering, 2018.
Pinter, Viktor: Basics of Electrical Engineering, book one, Zagreb, Tehnička knjiga, 1994.
Pinter, Viktor: Basics of Electrical Engineering, book two, Zagreb, Tehnička knjiga, 1994.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators analyzing the students' studies, passing of exams, employment rates of graduates and other quality indicators.
Regular updating and modernizing of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Slavko Majstorović, lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Sensors</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">1st</td><td>Semester</td><td colspan="3">1st</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">5</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">30 + 30 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td></td><td>30</td><td>12</td><td>18</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The goal of this course is to learn the basic concepts and analyze the working principle and characteristics of analog and digital sensors. The course covers the acquisition of basic methods and examples of selected sensors.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Principle of operation, types and characteristics of sensors</td><td>O1</td><td colspan="5">Analyze the principle of operation and characteristics of analog sensors</td></tr>
<tr><td>O2</td><td colspan="5">Analyze the working principle and characteristics of digital sensors</td></tr>
<tr><td>O3</td><td colspan="5">Analyze the working principle and characteristics of presence sensors with binary output</td></tr>
<tr><td rowspan="5">ULO2</td><td rowspan="5">Sensor application</td><td>O4</td><td colspan="5">Carry out the sensor calibration procedure</td></tr>
<tr><td>O5</td><td colspan="5">Calculate the value of the measured physical quantity based on the output of analog or digital sensors</td></tr>
<tr><td>O6</td><td colspan="5">Choose the appropriate sensor for the given purpose</td></tr>
<tr><td>O7</td><td colspan="5">Connect the sensor to the electronic device</td></tr>
<tr><td>O8</td><td colspan="5">Carry out an experimental measurement of a physical quantity using a sensor</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Principle of operation, types and characteristics of sensors (Outcome 1, Outcome 2, Outcome 3)
1.1. Sensors, signals and systems with sensors
1.2. Sensor classifications
1.3. Measurement units and sizes
1.4. Sensor characteristics – measuring range, accuracy, calibration errors, non-linearity, saturation, repeatability, resolution, output types, reliability.
1.5. Physical principles of sensor operation - magnetism, capacitance, induction, resistance, piezoelectric phenomena, pyroelectric phenomena, Hall effect, thermoelectric phenomena, sound waves, heat.</td></tr>
</table>

1.6. Sensors, signals and systems with sensors
1.7. Measurement units and sizes
1.8. Sensor characteristics – measuring range, accuracy, calibration errors, non-linearity, saturation, repeatability, resolution, output types, reliability.
1.9. Physical principles of sensor operation - magnetism, capacitance, induction, resistance, piezoelectric phenomena, pyroelectric phenomena, Hall effect, thermoelectric phenomena, sound waves, heat.
1.10. Sensors based on the principle of light transmission and modulation - light, propagation and scattering of light rays, geometric properties, radiometry, photometry, mirrors, lenses, characteristics of optical sensors, optical guides, systems based on optical concepts.
1.11. Sensor interfaces – signal modulators, electronic concepts and circuits, excitation circuits, analog-to-digital converters, integrated circuits, data transmission, interference in data transmission, battery power supplies.
1.12. Sensors for people and motion detection
1.13. Presence, displacement and level sensors
1.14. Speed and acceleration sensors
1.15. Force and tension sensors
1.16. Pressure sensors
1.17. Flow sensors
1.18. Sound sensors
1.19. Moisture and humidity sensors
1.20. Sensors for detecting light and light radiation
1.21. Ionizing radiation sensors
1.22. Temperature sensors
1.23. Chemical and biological sensors

2. Sensor application (Outcome 4, Outcome 5, Outcome 6, Outcome 7, Outcome 8)
2.1. Calibration procedures of selected sensors
2.2. The process of calculating measured quantities based on the data collected by the selected sensor
2.3. Examples of systems and the selection of suitable sensors for the purpose of the system
2.4. The method of connecting selected sensors with different system categories
2.5. Experimental measurement of a physical quantity using a sensor system
2.6. The impact and use of artificial intelligence and machine learning in sensor systems
2.7. Sensor systems and virtual, augmented and mixed reality technologies
2.8. Sensor systems in the modern automotive industry
2.9. Sensor systems in the entertainment industry - video games, systems for training, learning and smart maintenance
2.10. Sensor technologies in systems based on the Internet of Things concept

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☐ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

- Full-time students must attend 5 out of 7 laboratory exercises.
- Part-time students must attend 4 out of 7 laboratory exercises.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam	X	Essay		Research	

Project		Continuous knowledge assessment	X	Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Laboratory exercises	Threshold	Max
ULO1	O1	12%			6%	**12%**
	O2	16%			8%	**16%**
	O3	12%			6%	**12%**
ULO2	O4		10%		5%	**10%**
	O5		10%		5%	**10%**
	O6		10%		5%	**10%**
	O7		10%		5%	**10%**
	O8			20%	10%	**20%**
	Total	**40%**	**40%**	**20%**	**50%**	**100%**

The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome and on the laboratory exercises. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Report from laboratory exercises	Threshold	Max
ULO1	O1	12%			6%	**12%**
	O2	16%			8%	**16%**
	O3	12%			6%	**12%**
ULO2	O4		10%		5%	**10%**
	O5		10%		5%	**10%**
	O6		10%		5%	**10%**
	O7		10%		5%	**10%**
	O8			20%	10%	**20%**
	Total	**40%**	**40%**	**20%**	**50%**	**100%**

Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period. The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome and on the laboratory exercises. If the student does not achieve a percentage of points in the laboratory exercises that is greater than or equal to the defined threshold, she or he submits a report that includes all laboratory exercises at the exam deadline. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Slavko Majstorović: Presentations from lectures and materials for exercises from course "Sensors", available at e-learning system Merlin	online	30

Supplementary reading materials:

Fraden, J. (2016). *Handbook of Modern Sensors: Physics, Designs, and Applications.* San Diego, USA: Springer.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Tomislav Pavlic, PhD, professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Technical Documentation of a Mechatronic System</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">1st</td><td>Semester</td><td colspan="3">1st</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">5</td></tr>
<tr><td rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">30 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td></td><td></td><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquire the knowledge needed to understand and create technical documentation and the knowledge needed to perform professional work in the domain of the profession.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Constituent elements of technical documentation</td><td>O1</td><td colspan="5">Apply rules and norms related to technical drawing and technical documentation</td></tr>
<tr><td>O2</td><td colspan="5">Analyze the constituent elements of the technical documentation of the mechanical engineering project</td></tr>
<tr><td>O3</td><td colspan="5">Analyze the constituent elements of the technical documentation of the electrical project</td></tr>
<tr><td rowspan="4">ULO2</td><td rowspan="4">Technical documentation of the mechatronic system</td><td>O4</td><td colspan="5">Draw the elements of machines and devices in orthogonal and isometric projection</td></tr>
<tr><td>O5</td><td colspan="5">Create 2D drawings of parts and assemblies using the CAD system</td></tr>
<tr><td>O6</td><td colspan="5">Create electrical and electronic schematics using EDA or CAD systems</td></tr>
<tr><td>O7</td><td colspan="5">Create technical documentation of the mechatronic system</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">Introduction to technical drawing (Outcome O1)
Standardization and standards: lines, technical letter, paper formats for technical documentation, standards, components, marking of documentation. G-code marking standards and rules.
Documentation in mechanical engineering (Outcome O1, O2)
Describing the shape of machine parts by orthogonal and isometric projection. Use of sections and recommendations when presenting shapes in technical documentation. Simplifications of the presentation of machine elements. Spatial presentation. Listing. Surface roughness and labeling on the documentation. Dimensional tolerances. Shape and position tolerances.</td></tr>
</table>

Standardization and standards: lines, technical letter, paper formats for technical documentation, standards, components, marking of documentation. G-code marking standards and rules.

Documentation in mechanical engineering (Outcome O1, O2)

Describing the shape of machine parts by orthogonal and isometric projection. Use of sections and recommendations when presenting shapes in technical documentation. Simplifications of the presentation of machine elements. Spatial presentation. Listing. Surface roughness and labeling on the documentation. Dimensional tolerances. Shape and position tolerances.

Documentation in electrical engineering (Outcome O3)

Element labeling system. Graphic symbols in drawings and schemes. Electrical diagrams (single-pole, multi-pole, assembly view. Technical description. Technical specifications of devices and equipment. Calculation of heating and selectivity. Instructions for operation and maintenance. Documentation of the derived state. Reading electrical diagrams.

Types of technical documentation (Outcome O1, O2, O3)

Design, construction, technological, production. Production sequence and application.

Use of computers in the preparation of technical documentation (Outcome O3, O4, O5, O6, O7)

Introduction to working with software tools for creating technical documentation.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

Attendance in accordance with the Study Regulations.
Creation of all defined tasks.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam		Oral exam		Essay		Research	
Project	X	Continuous knowledge assessment	X	Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Project task	Threshold	Max
ULO1	O1	15%			7.5%	**15%**
	O2	15%			7.5%	**15%**
	O3			10%	5%	**10%**
ULO2	O4		10%		5%	**10%**
	O5		10%		5%	**10%**
	O6		10%		5%	**10%**
	O7			30%	15%	**30%**
	Total	**30%**	**30%**	**40%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
Outcomes that the student does not pass during the continuous assessment, will be taken during the examination period.
Outcome O7 includes a project task from mechanical engineering, and Outcome O3 includes a project task from electrical engineering.

Exam term:

ULO	Outcomes	Written exam	Project task	Threshold	Max
ULO1	O1	15%		7.5%	**15%**
	O2	15%		7.5%	**15%**
	O3		10%	5%	**10%**
ULO2	O4	10%		5%	**10%**
	O5	10%		5%	**10%**
	O6	10%		5%	**10%**
	O7		30%	15%	**30%**
	Total	**60%**	**40%**	50%	**100 %**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
A passed learning outcome through continuous verification or through the exam term is “valid” for one calendar year, after which it is retaken.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Pavlic, Tomislav: Lectures and exercises from course “Technical documentation”, the Bjelovar University of Applied Sciences.	online	30
Kukec, Đuro: Technical documentation, Technical College in Bjelovar, 2011.	10	
SchrackCAD documentation, instructions for work	online	30

Supplementary reading materials:
1. Padovan, Lukša: ”Engineering graphics and documentation”, Graphis d.o.o. Zagreb, Zagreb, 2004. 2. Švigir, Nikola; Sumina, Damir; Padovan, Lukša: ”Technical drawing using CAD programs”, Graphis d.o.o. Zagreb, 2007. 3. Žunar, Milan: ”Technical Drawing”, Profil Mozaik d.o.o. Zagreb, Zagreb, 2008. 4. Rodeš, Vladimir: “Electrical installations”, Electrical Engineering School, Varaždin, 2009 - Part 1 and 2
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students’ studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td colspan="2">Lead instructor</td><td colspan="6">Ivan Sekovanić, senior lecturer</td></tr>
<tr><td colspan="2">Course name</td><td colspan="6">Fundamentals of the Programming Language Python</td></tr>
<tr><td colspan="2">Study program</td><td colspan="6">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td colspan="2">Course status</td><td colspan="6">Compulsory</td></tr>
<tr><td colspan="2">Year</td><td>1st</td><td colspan="2">Semester</td><td colspan="2">1st</td></tr>
<tr><td colspan="2" rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="4">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">15 + 30 + 0</td><td>L</td><td colspan="2">E</td><td>S</td></tr>
<tr><td>15</td><td>AE</td><td>LE</td><td></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">1. Develop the ability to use an algorithmic approach to problem solving.
2. Acquire basic knowledge of programming in the Python programming language.
3. Develop logical thought processes in the process of solving problems.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Fundamentals of data placement and processing in programming</td><td>O1</td><td colspan="5">Implement a designed simple algorithm according to guidelines using the basic elements of the chosen programming language</td></tr>
<tr><td>O2</td><td colspan="5">Apply more complex mathematical and logical operations on the elements of the selected container to store more data in the selected programming language</td></tr>
<tr><td>O3</td><td colspan="5">Design a solution to a simple problem by constructing functions in the selected programming language.</td></tr>
<tr><td rowspan="3">ULO2</td><td rowspan="3">Fundamentals of more efficient data placement and processing in programming</td><td>O4</td><td colspan="5">Implement a simple user data type in the default programming language according to the described problem.</td></tr>
<tr><td>O5</td><td colspan="5">Create a solution using the stack and heap data structures in the given programming language.</td></tr>
<tr><td>O6</td><td colspan="5">Construct a program solution in the given programming language that reads and writes data to files.</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Programming languages and programming
History of programming languages. Possible application of programming. Program development. To think like a programmer.
2. Python programming language (O1)</td></tr>
</table>

Introduction to Python. Installing Python on Windows. Programming the "Hello World" program. Python syntax.

3. Handling simple data (O1)

Standard data types. Variables. Display numbers. Arithmetic operators. Comparison operators. Join operators. Logical operators. Bit operators. Operator priority. Type conversions data. Mathematical functions. Simple input-output functions.

4. Management during program execution (O2)

Conditional performance. Conditional commands with one clause and multiple clauses. Nesting conditionals orders. Program loops. The while loop. Loop for. Break and continue commands. The command pass.

5. Character strings (O2)

String data type. Special characters in character strings. Formatting character strings. Operations on character strings.

6. Collections of objects (O2)

Next collections. Sheets. List operations. Matrices. N-tuples. Operations on n-tuples. Associative collections. Dictionaries. Operations on dictionaries. Assemblies. Operations on sets.

7. Functions (O3)

Definition of a function. Function call. Function arguments. Return values of functions. Variable reach.

8. Files (O6)

File operations. Reading and writing text and binary files.

9. Application of programming language elements to the described problem. (O1, O2, O3, O4, O5, O6)

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☐ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☐ other:

Students' obligations

- Attending lectures and exercises according to the Study Regulations.

Monitoring students' work

Attendance		Activity in class	x	Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	x	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Activity	Laboratory exercises	Threshold	Max
ULO1	O1	13%		1%	4%	9%	**18%**
	O2	20%		4%	9%	16.5%	**33%**
	O3		17%	1%	6%	12%	**24%**
ULO2	O4		3%	2%	2%	3.5%	**7%**
	O5		4%	1%	1%	3%	**6%**
	O6		8%	1%	3%	6%	**12%**
	Total	**33%**	**32%**	**10%**	**25%**	**50%**	**100%**

The student passed the course if she or he achieved a percentage of points that is greater than or equal to each learning outcome to the defined threshold. The first Mid-term exam is written in the middle of the semester, while the second Mid-term exam is written at the end semester. Points from activities are achieved through appropriate activities in lectures. Students, through the activity, in addition to the regular 10 points, can earn up to 7 additional points that are evenly distributed to all outcomes. If a student achieves, for example, 3 additional points, 0.5 is added to each outcome point. At the same time, the total points from outcome cannot exceed the maximum amount. For example, to a student who achieves 21.5 out of 22 points from outcome 3 and 1 additional point on that outcome total is awarded 22 points from outcome, not 22.5.

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	18%	9%	**18%**
	O2	33%	16.5%	**33%**
	O3	24%	12%	**24%**
ULO2	O4	7%	3.5%	**7%**
	O5	6%	3%	**6%**
	O6	12%	6%	**12%**
	Total	**100%**	**50%**	**100%**

The student passed the course if she or he achieved a percentage of points that is greater than or equal to each learning outcome to the defined threshold. Outcomes that the student does not pass during the continuous assessment, will be passed on exam period. Passed learning outcomes are transferred to the next exam dates and are not required to be retaken.
After the 4th exam term, if not all learning outcomes have been passed, all achieved results are canceled and it is necessary to pass all outcomes of the program studies again.
Passed learning outcomes through continuous testing or through the exam term are valid until the classes in the course are attended fully by the next generation of students. Once the course has been run again, all outcomes are canceled and they need to be taken again.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)

60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Sekovanić, Ivan: "Presentation of lectures and exercises – Fundamentals of the Programming Language Python", the Bjelovar University of Applied Sciences	online	30
Kalafatić, Zoran; Pošćić, Antonio; Šegvić, Siniša; Šribar, Julijan: Python for the curious, Element, Zagreb, 2016.	15	30

Supplementary reading materials: .

Michael Dawson: Python Programming for the Absolute Beginner, 3rd Edition, Course Technology, Boston, 2010.
Severance, Charles: Python for Everybody, Online, https://www.py4e.com/lessons

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="10">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="9">Tatjana Badrov, MSc, senior lecturer</td></tr>
<tr><td>Course name</td><td colspan="9">Communication Skills</td></tr>
<tr><td>Study program</td><td colspan="9">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="9">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">1st</td><td>Semester</td><td colspan="5">1st</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="8">3</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">15 + 30 + 0</td><td colspan="2">L</td><td colspan="3">E</td><td>S</td></tr>
<tr><td>AE</td><td colspan="2">LE</td><td></td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>15</td><td>30</td><td colspan="2"></td><td></td></tr>
<tr><td colspan="10">COURSE DESCRIPTION</td></tr>
<tr><td colspan="10">Course objectives</td></tr>
<tr><td colspan="10">The goal of the course is to improve students' communication skills.</td></tr>
<tr><td colspan="10">Conditions for enrollment into the course</td></tr>
<tr><td colspan="10">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="10">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="8">Learning outcomes</td></tr>
<tr><td rowspan="6">ULO1</td><td rowspan="6">Basics of communication skills for students of engineering studies</td><td>O1</td><td colspan="8">Explain the basic terms of verbal and non-verbal communication and obstacles in communication</td></tr>
<tr><td>O2</td><td colspan="8">Write an official letter and/or resume</td></tr>
<tr><td>O3</td><td colspan="8">Apply techniques of information gathering, active listening and giving and receiving feedback</td></tr>
<tr><td>O4</td><td colspan="8">Differentiate basic communication styles, possible objections and conflicts</td></tr>
<tr><td>O5</td><td colspan="8">Evaluate the quality of presentation of technical services, products or projects</td></tr>
<tr><td>O6</td><td colspan="8">Represent an opinion and argue during debates and negotiations</td></tr>
<tr><td colspan="10">Course content</td></tr>
<tr><td colspan="10">1. Introduction to communication (Outcome O1)
The concept of communication. Levels of communication phenomena (intrapersonal, interpersonal, group, public and mass communication). Goals, principles and types of communication. Communication difficulties.
2. Verbal communication (Outcome O1)
Factors of effectiveness and appropriateness and verbal communication. Preconceptions about communication. Aspects of the message. Criteria of successful verbal communication. Connotative and denotative level of meaning of verbal communication. Online communication.
3. Nonverbal and paraverbal communication (Outcome O1)
Elements of non-verbal communication. Functions of non-wave communication.
4. Writing a business letter and resume (Outcome O2)
Parts of a business letter. Official correspondence by electronic mail.</td></tr>
</table>

5. **Information gathering skills** (Outcome O3)
Questioning techniques and skills. Types of questions according to the goal of communication.
6. **Techniques and skills of active listening** (Outcome O3)
Listening as a physical and mental activity. Types of (non)listening. Principles of active listening.
7. **Techniques for providing feedback** (Outcome O3)
Concept and purpose of feedback. Five main categories of feedback. Balanced feedback. Receiving and giving praise.
8. **Communication styles** (Outcome O4)
Aggressive, submissive-aggressive, passive, assertive communication style. The connection between communication style and the outcome of communication. The concept and meaning of assertiveness. Principles of assertive communication. The construction and effect of the ME-message in relation to the YOU-message.
9. **Recognition and resolution of objections** (Outcome O4)
The concept of objection. Types of complaints. General rules for dealing with complaints. Resolving complaints based on the type of complaint. Conflicts. Types of conflict. Positive and negative consequences of conflict.
10. **Self-presentation and impression management** (Outcome O5)
Impression management skills. Five main self-presentation strategies.
11. **Presentation techniques and skills 1** (Outcome O5)
Preparation and design of the presentation. The structure of the presentation. Verbal and non-verbal elements of public presentation.
12. **Presentation techniques and skills 2** (Outcome O5)
Preparation and design of the presentation. The structure of the presentation. Verbal and non-verbal elements of public presentation. Answering questions.
13. **Negotiation 1** (Outcome O6)
Definition of negotiation and negotiation situation. Traits of successful negotiators. Preparation of negotiations.
Negotiation strategies.
14. **Negotiation 2** (Outcome O6)
Tactics and techniques for the initial, middle and final stages of negotiations. Ethical and unethical techniques/tactics in negotiations. Negotiating in different cultures.
15. **Debate** (Outcome O6)
The concept of debate. Debate participants. Parts of the debate. Debate in the function of developing critical, logical and creative thinking.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☐ laboratory ☐ mentor work ☐ other:

Students' obligations

- Preparation and performance of practical tasks.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	

Project		Continuous knowledge assessment	X	Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Practical assignment	Threshold	Max
ULO 1	O1	30%			**15%**	**30%**
	O2			10%	**5%**	**10%**
	O3		14%		**7%**	**14%**
	O4		14%		**7%**	**14%**
	O5			18%	**9%**	**18%**
	O6		14%		**7%**	**14%**
	Total	**30%**	**42%**	**28%**	**50%**	**100%**

The student passed the course if he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Written exam	Practical assignment	Threshold	Max
ULO1	O1	30%		**15%**	**30%**
	O2		10%	**5%**	**10%**
	O3	14%		**7%**	**14%**
	O4	14%		**7%**	**14%**
	O5		18%	**9%**	**18%**
	O6	14%		**7%**	**14%**
	Total	**72%**	**28%**	**50%**	**100%**

Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period. The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course		
Title	Number of copies	Number of students
Badrov, T, (2020): Communication skills in engineering, the Bjelovar University of Applied Sciences	online	30
Teaching materials available on the Merlin e-learning system	online	30
Supplementary reading materials:		
Tomić, Z., Jugo, D. (2021), Foundations of interpersonal communication, Synopsis, Zagreb Reardon, K. (1998): Interpersonal communication - Where thoughts meet, Alineja, Zagreb Fox, R. (2006): Business communication, Croatian University Press, Zagreb		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Ivana Marušić, senior lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Mathematics 2</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">1st</td><td>Semester</td><td colspan="3">2nd</td></tr>
<tr><td rowspan="2">Credit value and teaching method</td><td>Students' ECTS workload coefficient</td><td colspan="6">5</td></tr>
<tr><td rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">30 + 45 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="6"></td><td>30</td><td>45</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The objective of the course is to master the basics of analytical geometry in space and the basics of differential and integral calculus.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Previously enrolled course Mathematics 1.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="2">ULO1</td><td rowspan="2">Basics of analytic geometry in space</td><td>O1</td><td colspan="5">Write the equation of a line and a plane for given input data</td></tr>
<tr><td>O2</td><td colspan="5">Solve problems with lines and planes in space</td></tr>
<tr><td rowspan="3">ULO2</td><td rowspan="3">Basics of differential calculus</td><td>O3</td><td colspan="5">Calculate the limes of the given function</td></tr>
<tr><td>O4</td><td colspan="5">Calculate the derivatives of the sum, difference, product, quotient and composition of functions</td></tr>
<tr><td>O5</td><td colspan="5">Apply differential calculus to modeling problems from different sciences</td></tr>
<tr><td rowspan="3">ULO3</td><td rowspan="3">Basics of integral calculus</td><td>O6</td><td colspan="5">Solve the indefinite integral using the appropriate method</td></tr>
<tr><td>O7</td><td colspan="5">Solve the definite integral using the appropriate method</td></tr>
<tr><td>O8</td><td colspan="5">Apply integral calculus to modeling and solving problems in the natural, technical or social sciences</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Analytical geometry (Outcome O1, O2)
The equation of the plane. Equation of direction. Intersection of a line and a plane. The intersection of two directions. Orthogonal projection of a point onto a line. Orthogonal projection of a point onto a plane. Orthogonal projection of a line onto a plane. Distance of points. The distance of the line from the plane. Distance of a point from a line. Distance of parallel lines. Distance beyond the directions.
2. Derivation (Outcome O3, O4, O5)</td></tr>
</table>

Speed problem. The concept of derivation. Derivatives of elementary functions. Basic rules of derivation. Derivation of composition of functions. Derivation of the inverse function. Logarithmic derivation. Derivation of an implicitly given function. Higher order derivatives. Differential of a function. Derivation of a parametric given function. Continuity and derivability of a function. Application of differential calculus. Equation of tangent and normal. Indeterminate forms. Growth and decline of function. Extreme points. Concavity and convexity. Points of inflection. Function flow.

3. Indeterminate integral (Outcome O6)

Definition and basic properties. Tabular integrals. Replacement or substitution method. Method of partial integration. Integrating rational functions. Integrating trigonometric functions. Integrating irrational functions.

4. Definite integral (Outcome O7, O8)

Definition and properties of the definite integral. Newton-Leibnitz formula. Method of replacement or substitution in a definite integral. The method of partial integration in a definite integral. Improper integrals. Application of integral calculation. The surface of a planar figure. Arc length of a plane curve. The volume of the rotating body. The area of the rotating body.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☒ multimedia and network ☐ laboratory ☐ mentor work ☐ other:

Students' obligations

- Attending lectures and auditory exercises according to the Study Regulations.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Mid-term exam 3	Threshold	Max
ULO1	O1	8%			4%	**8%**
	O2	12%			6%	**12%**
ULO2	O3		8%		4%	**8%**
	O4		20%		10%	**20%**
	O5		12%		6%	**12%**
ULO3	O6			14%	7%	**14%**
	O7			14%	7%	**14%**
	O8			12%	7%	**12%**

	Total	**20%**	**40%**	**40%**	**50%**	**100%**

The student passed the course if he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught. Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period.

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	8%	4%	**8%**
	O2	12%	6%	**12%**
ULO2	O3	8%	4%	**8%**
	O4	20%	10%	**20%**
	O5	12%	6%	**12%**
ULO3	O6	14%	7%	**14%**
	O7	14%	7%	**14%**
	O8	12%	7%	**12%**
	Total	**100%**	**50%**	**100%**

The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Tomić, Milorad: Mathematics 2, Technical College in Bjelovar Bjelovaru, Bjelovar, 2009.	9	30
Marušić, Ivana: "Presentation of lectures and exercises – Mathematics 2", the Bjelovar University of Applied Sciences,	online	30

Supplementary reading materials:
Tomić, Milorad: Mathematics 1, Technical college in Bjelovar, Bjelovar, 2009. Pavlovič Demidović, Boris, and others: "Tasks and solved examples from Mathematical analysis for technical faculties", Golden marketing, Tehnička knjiga, Zagreb, 2003.
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences
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<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td colspan="2">Lead instructor</td><td colspan="6">Tomislav Pavlic, PhD, professional study program professor</td></tr>
<tr><td colspan="2">Course name</td><td colspan="6">Fundamentals of Mechanics 1</td></tr>
<tr><td colspan="2">Study program</td><td colspan="6">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td colspan="2">Course status</td><td colspan="6">Compulsory</td></tr>
<tr><td colspan="2">Year</td><td colspan="2">1st</td><td>Semester</td><td colspan="3">2nd</td></tr>
<tr><td colspan="2" rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">6</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">30 + 45 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>30</td><td>45</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquaint students with basic knowledge and problem solving in the field of statics and mechanics of deformable bodies.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="6">ULO1</td><td rowspan="6">Statics of rigid bodies: beam, frame and lattice supports</td><td>O1</td><td colspan="5">Apply the basic axioms and theorems of statics of rigid bodies, determine the resultant of forces and moment of force, and decompose the force into its components</td></tr>
<tr><td>O2</td><td colspan="5">Release the body of connections in the plane and space, set up the equilibrium equations and calculate the reactions of the connections</td></tr>
<tr><td>O3</td><td colspan="5">Calculate internal forces and moments in the cross section of beams and frame supports and draw diagrams of internal forces along the supports.</td></tr>
<tr><td>O4</td><td colspan="5">Calculate the geometric characteristics of the plane sections of the supports</td></tr>
<tr><td>O5</td><td colspan="5">Calculate internal forces in planar lattice structures</td></tr>
<tr><td>O6</td><td colspan="5">Calculate the center of gravity and moments of inertia and static moments of the surface</td></tr>
<tr><td rowspan="4">ULO2</td><td rowspan="4">Mechanics of deformable bodies: strength, stiffness and elastic stability</td><td>O7</td><td colspan="5">Explain the concepts of deformation, stress and Hooke's law</td></tr>
<tr><td>O8</td><td colspan="5">Calculate stresses and deformations of supports loaded with axial forces, loaded for shearing, twisting and bending in one plane</td></tr>
<tr><td>O9</td><td colspan="5">Determine the critical buckling force of a compressively loaded rod and evaluate the stability of the rod</td></tr>
<tr><td>O10</td><td colspan="5">Dimension axially loaded rod structures, shafts loaded in twisting and supports loaded in bending</td></tr>
</table>

Course content
Statics of rigid bodies. Basic concepts of force geometry. Reduction of the force system. Releasing the rigid body of the links. The principle of solidification. Body balance conditions. System balance. Analytical equilibrium conditions. Graphic sense of equilibrium conditions. Conditions of equilibrium of the body when friction acts. Friction in the contact of rigid bodies. Rope friction. Carriers. Methods of determining internal sizes. Centers of gravity of simple bodies. Centers of gravity of complex bodies. (Outcomes O1, O2, O3, O4, O5, O6). Stresses: definition of normal and shear stress, stress tensor, stress transformation, principal stresses. Deformations: definition of linear and angular deformation, deformation tensor, deformation transformation, main deformations. Hook's law. (Outcome O7) Axial load of the rod: assumptions and limitations, connection of deformations and displacements, axial stiffness, displacement plan, assembly and thermal stresses, dimensioning of rods. (Outcome O8) Twisting of round prismatic rods: assumptions and limitations, concept of twist angle and relative twist angle and their relationship, geometric and mechanical analysis, torsional stiffness, shaft dimensioning. (Outcome O9) Bending of straight prismatic rods: assumptions and limitations, geometric and mechanical analysis, flexural stiffness, pure bending, transverse bending, determination of deflection during bending, analog beam method, dimensioning of supports. (Outcome O10)

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☐ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations
Attendance in accordance with the Study Regulations. **Creation of all defined tasks.**

Monitoring students' work							
Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam	X	Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Mid-term exam 3	Thres-hold	Max
ULO1	O1	5%			2.5%	**5%**
	O2	5%			2.5%	**5%**
	O3	10%			5%	**10%**
	O4		10%		5%	**10%**
	O5		10%		5%	**10%**
	O6		10%		5%	**10%**
ULO2	O7			10%	5%	**10%**

	O8			20%	10%	**20%**
	O9			10%	5%	**10%**
	O10			10%	5%	**10%**
	Total	**20%**	**30%**	**50%**	**50%**	**100%**

student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
Outcomes that the student does not pass during the continuous assessment, will be taken during the examination period.

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	5%	2.5%	**5%**
	O2	5%	2.5%	**5%**
	O3	10%	5%	**10%**
	O4	10%	5%	**10%**
	O5	10%	5%	**10%**
	O6	10%	5%	**10%**
ULO2	O7	10%	5%	**10%**
	O8	20%	10%	**20%**
	O9	10%	5%	**10%**
	O10	10%	5%	**10%**
	Total	**100%**	**50%**	**100%**

The student has passed the course if for each learning outcome he has achieved a percentage of points that is greater than and equal to the defined threshold.
A passed learning outcome through continuous assessment or through the exam term is “valid” for one calendar year, after which it is retaken.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course		
Title	Number of copies	Number of students

Matejiček, Franjo; Semenski, Damir; Vnučec, Zdravko: "Introduction to statics with a collection of tasks", Faculty of Mechanical Engineering, Slavonski Brod, 2016.	12	30
Alfirević, Ivo. The science of strength I. Zagreb: Tehnička knjiga, 1995.	4	30
Supplementary reading materials:		
•Muftić, Osman: "Mechanics I, Statics", Tehnička knjiga, Zagreb, 1989. •Group of authors: "Engineering manual IP1, First volume – Mechanics", Školska knjiga, Zagreb, 1996. •Kraut, Bojan: „Kraut's Mechanic's Manual" 11th edition, Sajema d.o.o., Zagreb, 2009. Alfirević, Ivo. The science of strength II. Zagreb: Tehnička knjiga, 1999.		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Tomislav Pavlic, PhD, professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Virtual Modeling and Simulation</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">1st</td><td>Semester</td><td colspan="3">2nd</td></tr>
<tr><td rowspan="2">Credit value and teaching method</td><td>Students' ECTS workload coefficient</td><td colspan="6">5</td></tr>
<tr><td>Classes total (L+E+S)*</td><td>20 + 40 + 0</td><td>L</td><td colspan="2">E</td><td colspan="2">S</td></tr>
<tr><td></td><td></td><td></td><td>AE</td><td>LE</td><td></td></tr>
<tr><td></td><td></td><td></td><td>20</td><td>0</td><td>40</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquire and learn to use the knowledge necessary for understanding, modeling, simulating and digital production of positions and assemblies of mechatronic systems, as well as creating accompanying documentation.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="3">Unit of learning outcomes</td><td colspan="5">Learning outcomes</td></tr>
<tr><td rowspan="4">ULO1</td><td rowspan="4">3D design</td><td>O1</td><td colspan="5">Differentiate the basic terms related to virtual modeling of parts and assemblies</td></tr>
<tr><td>O2</td><td colspan="5">Apply programming tools for virtual design of production systems</td></tr>
<tr><td>O3</td><td colspan="5">Create CAD models of parts, assemblies and entire production systems</td></tr>
<tr><td>O4</td><td colspan="5">Create technical documentation from finished models and assemblies</td></tr>
<tr><td rowspan="2">ULO2</td><td rowspan="2">Virtual modeling and simulation of production processes</td><td>O5</td><td colspan="5">Model production processes in a virtual environment</td></tr>
<tr><td>O6</td><td colspan="5">Simulate production processes in a virtual environment</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">

Basics of software CAD tools for 2D and 3D modeling. Bases of standard parts. Transition from 3D models to *.dxf and *.dwg industry standards. Modeling using surfaces. Modeling of welded structures. Construction of pipelines. Part modeling. Circuit modeling. 3D modeling in sheet metal processing. Rendering and creation of photorealistic images of mechatronic systems from created 3D models. (Outcomes O1, O2, O3)
Technical documentation for virtual modeling of mechatronic systems. 2D technical documentation. Standards in mechatronics. (Outcome O4)
Creation of animations of mechatronic systems. Introduction to creating simulations. Wiring of distribution cabinets. Preparation of 3D models for use and integration in CAD/CAM/CNC systems, i.e. in general for the needs of digital production. Virtual, augmented and mixed reality. Holographic technologies. (Outcomes O5 and O6)

</td></tr>
</table>

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

Attendance in accordance with the Study Regulations.
Creation of all defined tasks.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project	X	Continuous knowledge assessment	X	Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Project task	Thres-hold	Max
ULO1	O1	15%			7.5%	**15%**
	O2	15%			7.5%	**15%**
	O3		15%		7.5%	**15%**
	O4		15%		7.5%	**15%**
ULO2	O5			20%	10%	**20%**
	O6			20%	10%	**20%**
	Total	**30%**	**30%**	**40%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
Outcomes that the student does not pass during the continuous assessment, will be taken during the examination period. Outcomes O5 and O6 include a project task.

Exam term:

ULO	Outcomes	Written exam	Project task	Thres-hold	Max
ULO1	O1	15%		7.5%	**15%**
	O2	15%		7.5%	**15%**
	O3	15%		7.5%	**15%**
	O4	15%		7.5%	**15%**
ULO2	O5		20%	10%	**20%**
	O6		20%	10%	**20%**
	Total	**60%**	**40%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
A passed learning outcome through continuous assessment or through the exam term is “valid” for one calendar year, after which it is retaken.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Pavlic, Tomislav: Lectures and exercises from the course Virtual modeling and simulation. Pavlic, Tomislav: Virtual design of mechatronic systems: basics for work in the SolidWorks programming environment. Bjelovar: the Bjelovar University of Applied Sciences, 2020	online	30

Supplementary reading materials:

1. Randy H. Shih: SolidWorks 2008 parametric modeling

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students’ studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

GENERAL INFORMATION						
Lead instructor	Goran Benkek, lecturer					
Course name	Electronic Components and Assemblies					
Study program	Professional undergraduate study program in Mechatronics					
Course status	Compulsory					
Year	1.	**Semester**	2.			
Credit value and teaching method	**Students' ECTS workload coefficient**	**5**				
	Classes total (L+E+S)*	30 + 30 + 0	P	V		S
				AV	LV	
			30	16	14	0

COURSE DESCRIPTION			
Course objectives			
Acquire basic knowledge about electronic components and circuits.			
Conditions for enrollment into the course			
Equal to the conditions for access to obtaining the qualification.			
Expected learning outcomes			
Unit of learning outcomes		**Learning outcomes**	
ULO1	Basics of semiconductor electronics	**O1**	Explain the basic properties of semiconductors
		O2	Analyze the electrical characteristics of diodes
		O3	Analyze the electrical characteristics of bipolar and unipolar transistors
		O4	Design a simple electronic circuit with the basic elements of semiconductor electronics
ULO2	Components of power electronics, circuits with operational amplifiers and optoelectronic components	**O5**	Analyze the operation of rectifiers, stabilizers and basic components of power electronics
		O6	Parameterize simpler circuits with an operational amplifier
		O7	Analyze the operation of optoelectronic components

Course content

1. Introduction to electronics and basic properties of semiconductors (Outcome O1)
Electrical properties of semiconductors, types of carriers, types of semiconductors, current conduction in semiconductors, generation and recombination processes, concentration of carriers in semiconductors.

2. **Pn junction and pn diode** (Outcome O2)
Structure of pn diode, pn junction in equilibrium and contact potential, polarization of pn junction, current-voltage characteristic and breakdown, types of diodes, metal-semiconductor junction.

3. **Bipolar and unipolar transistors** (Outcome O3)
Structure, principle of operation, determination of current components, current-voltage characteristics.

4. **Application of semiconductor components in electronic circuits** (Outcome O4)

Application of a pn diode in an electronic circuit, a transistor as a switch, a transistor as an amplifier.

5. **Power electronics** (Outcome O5)

Electrical properties of semiconductors, types of carriers, types of semiconductors, current conduction in semiconductors, generation and recombination processes, concentration of carriers in semiconductors.

6. **Operational amplifiers** (Outcome O6)

Basic properties of amplifiers, performance of amplifiers, applications of operational amplifiers, feedback circuits.

7. **Optoelectronic components** (Outcome O7)

Photoresistors, photodiodes, light-emitting diodes, laser diodes, phototransistors.

Teaching formats	☒ lectures	☐ independent work
	☐ seminars and workshops	☐ multimedia and network
	☒ exercises	☒ laboratory
	☐ distance education	☐ mentor work
	☐ field course	☐ other: flipped classroom

Students' obligations

- Full-time students must attend 5 out of 7 laboratory exercises.
- Part-time students must attend 4 out of 7 laboratory exercises.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Laboratory exercises	Activity	Thres-hold	Max
ULO1	O1	16%				8%	**16%**
	O2	16%				8%	**16%**
	O3	16%				8%	**16%**
ULO2	O4		8%			4%	**8%**
	O5		8%			4%	**8%**
	O6		8%			4%	**8%**
	O7		8%			4%	**8%**
				14%	6%	10%	**20%**
	Total	**48%**	**32%**	**14%**	**6%**	**50%**	**100%**

The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome and on the scoring part outside the learning outcome (laboratory exercises + activity). Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Written exam	Report from laboratory exercises	Thres-hold	Max
ULO1	O1	16%		8%	**16%**
	O2	16%		8%	**16%**
	O3	16%		8%	**16%**
ULO2	O4	8%		4%	**8%**
	O5	8%		4%	**8%**
	O6	8%		4%	**8%**
	O7	8%		4%	**8%**
			20%	10%	**20%**
	Total	**80%**	**20%**	**50%**	**100%**

The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome and on the scoring part outside the learning outcome (laboratory exercises + activity) has achieved a percentage of points that is greater than or equal to the defined threshold. If a student does not achieve a percentage of points that is greater than or equal to the defined threshold in the part of scoring outside of the learning outcome, she or he submits a report that includes all laboratory exercises at the exam deadline. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Butković, Ž., Divković Pukšec J., Barić A. (2013). Electronics 1: Part 1. Zagreb: Faculty of Electrical Engineering and Computing	15	30
Butković, Ž., Divković Pukšec J., Barić A. (2013). Electronics 1: Part 2. Zagreb: Faculty of Electrical Engineering and Computing	15	30
Benkek, Goran: "Presentation of lectures and exercises - Electronic components	online	30

and circuits", the Bjelovar University of Applied Sciences		
Supplementary reading materials:		
Brodić, Tomislav – Electronic elements and basic circuits, University of Zagreb, Zagreb, 1995. Grilec, Josip; Zorc, Davor – Fundamentals of Electronics, University of Zagreb, Zagreb, 2001. Biljanović, Petar – Electronic circuits, University of Zagreb, Zagreb, 2005. Vučetić, Dubravko – Energy Electronics, University of Rijeka, Rijeka, 2009. Bindal, Ahmet – Electronics for Embedded Systems, Springer, 2017.		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td colspan="2">Lead instructor</td><td colspan="6">Krunoslav Husak, senior lecturer</td></tr>
<tr><td colspan="2">Course name</td><td colspan="6">Fundamentals of the Programming Language C</td></tr>
<tr><td colspan="2">Study program</td><td colspan="6">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td colspan="2">Course status</td><td colspan="6">Compulsory</td></tr>
<tr><td colspan="2">Year</td><td colspan="2">1st</td><td>Semester</td><td colspan="3">2nd</td></tr>
<tr><td colspan="2" rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">5</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">30 + 30 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>30</td><td></td><td>30</td><td></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquire the basics of programming in the procedural programming language C, which includes: use of data types, organization of program code using conditional blocks and program loops, correction of errors in program code, application of fields, application of character strings, application of existing functions and macros, and creation of own functions and macros.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Introduction to procedural programming language</td><td>O1</td><td colspan="5">Apply data types for program variables in procedural programming language</td></tr>
<tr><td>O2</td><td colspan="5">Organize a program using commands to control the flow of a program in a procedural programming language</td></tr>
<tr><td>O3</td><td colspan="5">Correct program code errors in procedural programming language</td></tr>
<tr><td rowspan="4">ULO2</td><td rowspan="4">Basics of programming in a procedural programming language</td><td>O4</td><td colspan="5">Apply one-dimensional and two-dimensional arrays of numbers in a procedural programming language</td></tr>
<tr><td>O5</td><td colspan="5">Apply character strings in a procedural programming language</td></tr>
<tr><td>O6</td><td colspan="5">Apply existing functions and macros in a procedural programming language</td></tr>
<tr><td>O7</td><td colspan="5">Create your own functions and macros in a procedural programming language</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Introduction to programming
History of programming. Programming in programming languages. Application of programming and examples. C programming language: The first program, The process of compiling C program code, Development environments for programming.
2. Introduction to programming language C (Outcome O1, O2, O3)</td></tr>
</table>

Comments. Identifiers. Data types. Variables. Operators, separators and literals: Association operator (=), Arithmetic operators (+, -, *, /, %). Increment/decrement operators (++, --). sizeof(). Standard input and output functions. Relational operators (<, >, ==, !=, >=, <=). Logical operators (&&, ||, !). Bit operators (&, |, <<, >>, ~) (Outcome O1)

Branching statements: if, if else, if else if, switch case. Conditional operator (?). Program loops: For loop, While loop, Do while loop, Nested loops, Break and continue commands, Infinite loop. Reach of variables (Outcome O2)

Correcting errors in the program code (Outcome O3)

3. **Data fields in programming language C** (Outcome O4, O5)

Data fields: One-dimensional fields, Two-dimensional fields (Outcome O4)

Character strings: Characters, Character strings (string), Header functions <string.h> (Outcome O5)

4. **Functions and macro commands in the programming language C** (Outcome O6, O7)

Functions: Function definition, Function declaration, Function call, Functions from libraries, User-defined functions. C standard library. Macros.

5. **Application of pointers, files and headers in the C programming language**

Indicators. Structures. Typedef. Working with files. Preprocessor directives. Headers.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

- Full-time students must attend 13 out of 15 laboratory exercises.
- Part-time students must attend 11 out of 15 laboratory exercises.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam		Oral exam	X	Essay		Research	
Project	X	Continuous knowledge assessment		Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Laboratory exercises	Home assignment	Mid-term exam 1	Mid-term exam 2	Thres-hold	Max
ULO 1	O1			10%		5%	**10%**
	O2			16%		8%	**16%**
	O3			6%		3%	**6%**
ULO 2	O4				12%	6%	**12%**
	O5				12%	6%	**12%**
	O6				12%	6%	**12%**
	O7				12%	6%	**12%**
		10%				5%	**10%**
			10%			5%	**10%**
	Total	**10%**		**32%**	**48%**	**50%**	**100%**

During laboratory exercises, students write short tests in which it is necessary to collect a number of points that is greater than or equal to the defined threshold. On home assignments, students must achieve a number of points equal to the defined threshold. Mid-term exams are written on a computer. The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome and evaluations outside the learning outcome.
Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Program assignment	Written exam	Thres-hold	Max
ULO 1	O1		10%	5%	**10%**
	O2		16%	8%	**16%**
	O3		6%	3%	**6%**
ULO 2	O4		12%	6%	**12%**
	O5		12%	6%	**12%**
	O6		12%	6%	**12%**
	O7		12%	6%	**12%**
		20%		10%	**20%**
	Total	**20%**	**80%**	**50%**	**100%**

Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period. If the student did not achieve the threshold on the laboratory exercises and home assignment during the continuous assessment, then she or he must achieve the threshold on the program assignment. A student can request a program assignment directly during any exam period from the course director and/or the instructor. If the student has achieved the threshold in laboratory exercises and home assignment, then these points are added up and represent the points of the program assignment. Once achieved points from the program task are kept until the points are deleted from all learning outcomes. The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome and evaluations outside the learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students

Zoran Vrhovski: Presentations from lectures and exercises from the course "Basics of programming", available on the Merlin e-learning system	Online	30
Domagoj Kusalić: Advanced programming and algorithms in C and C++, 5th edition, Element, Zagreb, 2014.	24	30
Supplementary reading materials:		
D. M. Ritchie, B. W. Kernighan (Translation: Ante Denić): Programming language C, second edition (https://www.scribd.com/doc/47734390/Programski-jezik-C) Rob Ostapiuk and Ingrid Tay: Basics of the C Programming Language, Microchip Technology Inc. url: https://microchipdeveloper.com/tls2101:start J. Šribar, B. Motik: Demystified C++, 3rd edition, Element, Zagreb, 2010. Learn C programming, http://www.tutorialspoint.com/cprogramming/		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Dario Vidić, adjunct senior lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Application of Tools in Office Management</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">1st</td><td>Semester</td><td colspan="3">2nd</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">15 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LEf</td></tr>
<tr><td colspan="2"></td><td>15</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquaint students with tools for office business and presentation of business results</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="2">ULO1</td><td rowspan="2">Application of writing and word processing tools</td><td>O1</td><td colspan="5">Format a document using formatting, insertion and document management tools.</td></tr>
<tr><td>O2</td><td colspan="5">Use word processing program tools to personalize and reference document elements.</td></tr>
<tr><td rowspan="3">ULO2</td><td rowspan="3">Application of tools for spreadsheet calculations.</td><td>O3</td><td colspan="5">Use tools for the purpose of formatting data, displaying them graphically, and managing worksheets and books.</td></tr>
<tr><td>O4</td><td colspan="5">Apply spreadsheet formulas or functions for data calculations.</td></tr>
<tr><td>O5</td><td colspan="5">Use spreadsheet tools to manage, organize, and display data.</td></tr>
<tr><td rowspan="2">ULO3</td><td rowspan="2">Application of tools for creating presentations</td><td>O6</td><td colspan="5">Enter, format and animate text and graphic elements and apply the existing design to the presentation.</td></tr>
<tr><td>O7</td><td colspan="5">Manage presentation output.</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Creation and editing of text documents (Outcome O1)
Using tools to create and edit text and other objects.
2. Work on existing text documents (Outcome O2)
Adding references, comments, notes. Creation of other types of documents (circular letters, templates, reports).
3. Tabular calculator (Outcome O3)
Using spreadsheet formatting tools. Management of workbooks and sheets. Adding objects to a worksheet. Editing workbook printouts.
4. Functions and formulas (Outcome O4)
Transforming data within a spreadsheet calculator using functions and formulas. Formatting data using more advanced methods.</td></tr>
</table>

5. Display of data in the table calculator (Outcome O5)
   Data preparation using tools for filtering, sorting, grouping and other data display options.
6. Making a presentation (Outcome O6)
   Adding multimedia content, slides and other elements to the presentation.
7. Content presentation (Outcome O7)
   Adding effects and adjusting other settings when presenting a presentation.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☐ other: flipped classroom

Students' obligations

- Full-time students must attend 14 out of 15 laboratory exercises.
- Part-time students must attend 12 out of 15 laboratory exercises.

Monitoring students' work

Attendance	X	Activity in class	X	Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Activity	Home assign-ment	Mid-term exam 1	Mid-term exam 2	Laboratory exercises	Thres-hold	Max
ULO1	O1	1%	1%	9%		3%	7%	**14%**
	O2	1%		8%		2%	5.5%	**11%**
ULO2	O3	1%	1%		10%	3%	7.5%	**15%**
	O4	1%	1%		14%	4%	10%	**20%**
	O5	1%			13%	1%	7.5%	**15%**
ULO3	O6	1%	1%	10%		2%	7%	**14%**
	O7	1%	1%	6%		3%	5.5%	**11%**
	Total	**7%**	**5%**	**33%**	**37%**	**18%**	**50%**	**100%**

The student passed the course if she or he achieved a percentage of points that is greater than or equal to each learning outcome by the defined threshold. The first Mid-term exam is written in the middle of the semester, while the second Mid-term exam is written at the end of the semester. Through the activity, in addition to the regular 7 points, students can earn up to 7 additional points that are evenly distributed among all outcomes. If a student achieves, for example, 3 additional points, 0.43 points are added to each outcome.

At the same time, the total points from outcomes cannot exceed the maximum amount. For example, to a student who achieves 19.5 out of 20 points from outcome 4 and on that outcome 1 additional point achieved through activities – the total is awarded 20 points from outcome, not 20.5.

Passed learning outcomes through continuous assessment or through the Exam term are "valid" until classes are being held and completed again with the next generation of students. Once the course is repeated, the points from all learning outcomes, home assignment and laboratory exercises are canceled and must be taken again during the exam period.

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	14%	7%	**14%**
	O2	11%	5.5%	**11%**
ULO2	O3	15%	7.5%	**15%**
	O4	20%	10%	**20%**
	O5	15%	7.5%	**15%**
ULO3	O6	14%	7%	**14%**
	O7	11%	5.5%	**11%**
	Total	**100%**	**50%**	**100%**

Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period. The student passed the course if she or he achieved a percentage of points that is greater than or equal to each learning outcome by the defined threshold.
Passed learning outcomes are transferred to the next exam dates and do not need to be taken again.
After the 4th exam term, if not all learning outcomes have been passed, all achieved results are deleted and it is necessary to pass all outcomes of the studies again.
Passed learning outcomes through continuous assessment or through the Exam term are "valid" until classes are being held and completed again with the next generation of students. Once the course is repeated, the points from all learning outcomes must be passed again during the exam period.
Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Vidić, Dario; Sekovanić, Ivan: "Presentation of lectures and exercises - Application of tools in office business ", the Bjelovar University of Applied Sciences	online	30

Supplementary reading materials:
Foulkes, Linda: Learn Microsoft Office 2021 - Second Edition, Packt Publishing, July 2022. Bulić, Biserka: Calculation sheets, https://www.srce.unizg.hr/sites/default/files/edu/Osnove%20uporabe%20racunala%20i%20interneta/E430_polaznik_20230916_0.pdf Bulić, Biserka: Calculation sheets – advaned level https://www.srce.unizg.hr/sites/default/files/edu/Osnove%20uporabe%20racunala%20i%20interneta/E440_polaznik_20231028.pdf Bulić, Biserka: Presentations, https://www.srce.unizg.hr/sites/default/files/edu/Osnove%20uporabe%20racunala%20i%20interneta/e630_polaznik.pdf
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Tomislav Pavlic, PhD, professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Fundamentals of Mechanics 2</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">2nd</td><td colspan="2">Semester</td><td colspan="2">3rd</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="6">6</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">30 + 45 + 0</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>L</td><td>AE</td><td>LE</td></tr>
<tr><td></td><td colspan="2"></td><td colspan="2">30</td><td>45</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquaint students with basic knowledge and problem solving in the field of kinematics and dynamics.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Basics of kinematics</td><td>O1</td><td colspan="5">Apply equations for determining the position, velocity and acceleration of a particle in rectilinear and curvilinear motion in Cartesian and polar coordinate systems</td></tr>
<tr><td>O2</td><td colspan="5">Determine the position, speed and acceleration of a particle during translation, rotation around a fixed axis and plane motion</td></tr>
<tr><td>O3</td><td colspan="5">Determine velocities, accelerations, current pole of velocity and current pole of acceleration in planar motion using velocity plan and acceleration plan</td></tr>
<tr><td rowspan="3">ULO2</td><td rowspan="3">Basics of dynamics</td><td>O4</td><td colspan="5">Apply Newton's second law of motion to a particle, a system of particles and a rigid body</td></tr>
<tr><td>O5</td><td colspan="5">Calculate mechanical work, power, kinetic energy, potential energy, momentum, moment of momentum and force impulse</td></tr>
<tr><td>O6</td><td colspan="5">Apply the laws of conservation of mechanical energy, kinetic energy, momentum and kinetic momentum to the motions of particles and rigid bodies</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">Introduction to kinematics and dynamics. Kinematics. Kinematics of a point. Trajectory, speed, acceleration. Rectilinear motion. Curvilinear motion (in the Descartes coordinate system, and using polar, cylindrical and natural coordinates). Rigid body kinematics. Translation. Rotation. Planar motion. Complex point motion (Outcome O1, O2, O3).
Dynamics. Basic laws of motion. Dynamics of a particle, a system of particles, a rigid body. Equation of motion. D'Alembert's principle. Work and power. Kinetic energy. Potential energy. Amount of motion. Kinetic moment.</td></tr>
</table>

Dynamic moments of inertia. Dynamics of a rigid body. Dynamics of translation, rotation and planar motion (Outcome O4, O5, O6).

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

Attendance in accordance with the Study Regulations.
Creation of all defined tasks.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Thres-hold	Max
ULO1	O1	20%		10%	**20%**
	O2	15%		7.5%	**15%**
	O3	15%		7.5%	**15%**
ULO2	O4		20%	10%	**20%**
	O5		15%	7.5%	**15%**
	O6		15%	7.5%	**15%**
	Total	**50%**	**50%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold. Outcomes that the student does not pass during the continuous assessment, will be taken during the examination period.

Exam term:

ULO	Outcomes	Written exam	Threshold	Max
ULO1	O1	20%	10%	**20%**
	O2	15%	7.5%	**15%**
	O3	15%	7.5%	**15%**
ULO2	O4	20%	10%	**20%**
	O5	15%	7.5%	**15%**
	O6	15%	7.5%	**15%**
	Total	**100%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
A passed learning outcome through continuous assessment or through the exam term is “valid” for one calendar year, after which it is retaken.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Matejiček, Franjo: Kinetics with a collection of problems, Faculty of Mechanical Engineering Slavonski Brod, Slavonski Brod, 2014.	12	30
Matejiček, Franjo: Kinematics with a collection of tasks, Faculty of Mechanical Engineering Slavonski Brod, Slavonski Brod, 2014.	12	30

Supplementary reading materials:

1. Jecić, Stjepan: “Mechanics 2, Kinematics and dynamics”, Tehnička knjiga, Zagreb, 1989.
2. Bazjanac, Davorin: “Technical mechanics Part II - Kinematics”, Tehnička knjiga, Zagreb, 1969.
3. Bazjanac, Davorin: “Technical mechanics part III - Dynamics”, Tehnička knjiga, Zagreb, 1974.
4. Group of authors: “Engineering handbook IP1, First volume - Mechanics”, Školska knjiga, Zagreb, 1996.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students’ studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

GENERAL INFORMATION							
Lead instructor	Dario Vidić, adjunct senior lecturer						
Course name	Fundamentals of Digital Logic						
Study program	Professional undergraduate study program in Mechatronics						
Course status	Compulsory						
Year	2nd	**Semester**	3rd				
Credit value and teaching method	**Students' ECTS workload coefficient**	**6**					
	Classes total (L+E+S)*	30 + 30 + 0	L	E		S	
				AE	LE		
			30	16	14	0	

COURSE DESCRIPTION

Course objectives

Acquaint students with the basic principles of building digital systems, starting with the elementary procedures of their analysis and design.

Conditions for enrollment into the course

Equal to the conditions for access to obtaining the qualification.

Expected learning outcomes

Unit of learning outcomes		Learning outcomes	
ULO1	Basics of number systems and codes	**O1**	Use methods to detect and correct errors in data transmission
		O2	Use number systems and codes to represent digital data
ULO2	Basics of Boolean algebra	**O3**	Apply the axioms and theorems of Boolean algebra to logical functions
		O4	Minimize and implement complex logic functions using basic logic circuits
ULO3	Basics of Digital Circuits	**O5**	Design a simple combinational digital circuit
		O6	Design a simple arithmetic digital circuit
		O7	Design a simple sequential digital circuit
		O8	Analyze the characteristics of static and dynamic memories
		O9	Analyze the operation of circuits for digital-analog and analog-digital conversion

Course content

1. **Number systems and codes** (Outcomes O1, O2)
Number systems (decadal, binary, hexadecimal, etc.). Conversion of numbers from one to another number system.
Operations with binary numbers. Characteristic binary and decade codes. Binary word encoding. Record the number in the computer. Methods for detecting and correcting data transmission errors.
2. **Boolean algebra and logical functions** (Outcome O3)
The logic of courts. Basic rules of Boolean algebra. AND, OR, NOT, EX-OR, NOR, NOR circuits.
3. **Minimization of logical functions** (Outcome O4)

Complex logical operations. Minterm and maxterm. Minimization methods (K tables, Quine's method). Implementation of logic circuits in semiconductor technology: TTL technique. CMOS technique.

4. **Combination circuits** (Outcome O5)

Adders. Digital comparator. Parity circuit. Encoder and decoder. Multiplexer and demultiplexer.

5. **Arithmetic circuits** (Outcome O6)

Adder, half-adder, multiplier, shift circuit

6. **Sequential circuits** (Outcome O7)

Bistables, synchronous and asynchronous counters, binary and decade counters, synchronous array generator, synchronous array detector

7. **Memories** (Outcome O8)

Characteristics of static and dynamic memories

8. **D/A and A/D conversion** (Outcome O9)

Interface of digital systems with analog environment, digital-analog and analog-digital conversion.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☐ other: flipped classroom

Students' obligations

- Attending lectures and auditory exercises according to the Study Regulations.
- Full-time students must attend 6 out of 7 laboratory exercises.
- Part-time students must attend 5 out of 7 laboratory exercises.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam	X	Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Activity	Laboratory exercises	Thres-hold	Max
ULO1	O1	5%			2%	3,50%	**7%**
	O2	6%			2%	4.00%	**8%**
ULO2	O3	3%			2%	2,50%	**5%**
	O4	4%			1%	2,50%	**5%**
	O5		4%		1%	2,50%	**5%**
ULO3	O6		11%		5%	8.00%	**16%**
	O7		12%		6%	9.00%	**18%**

	O8		7%		5%	6.00%	**12%**
	O9		9%		5%	7.00%	**14%**
				10%		5%	**10%**
	Total	**18%**	**43%**	**10%**	**29%**	**50%**	**100%**

The student passed the course if he achieved a percentage of points that is greater than or equal to the defined Threshold on each learning outcome. Points earned on the passed Learning outcomes are deleted one year after the beginning of the semester in which the course is taught. Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period. Points from the activity are achieved through appropriate activities in lectures and auditory exercises (e.g., a short test).

Exam term:

ULO	Outcomes	Written exam	Oral exam	Thres-hold	Max
ULO1	O1	7%		3,50%	**7%**
	O2	8%		4.00%	**8%**
ULO2	O3	5%		2,50%	**5%**
	O4	5%		2,50%	**5%**
	O5	5%		2,50%	**5%**
ULO3	O6	16%		8.00%	**16%**
	O7	18%		9.00%	**18%**
	O8	12%		6.00%	**12%**
	O9	14%		7.00%	**14%**
			10%	5%	**10%**
	Total	**90%**	**10%**	**50%**	**100%**

A student who obtained at least 5 points from the activity during the continuous assessment is exempted from taking the oral part of the exam. The student can take the oral exam if she or he has achieved the defined thresholds for each learning outcome and laboratory exercises. At the oral exam, the student must achieve the defined threshold, otherwise, at the next exam period, he/she can only take the oral exam (except in the case of the 4th or 8th time taking the exam - in that case, the achieved points according to learning outcomes are reset). Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course		
Title	Number of copies	Number of students
Vrhovski, Zoran; Šumiga Ivan: Digital technology – Collection of solved problems, Technical College in Bjelovar, Bjelovar, 2015.	10 Online	30
Dario Vidić: Lecture presentations from Basics of Digital Logic, the Bjelovar University of Applied Sciences, available on the e-learning system Merlin	Online	30
Supplementary reading materials:		
Peruško, Uroš: Digital electronics, Školska knjiga, Zagreb, 1996. S. D. Brown, Z. G. Vranešić (2001.), Basics of Digital Logic, https://notesavior.files.wordpress.com/2018/02/stephen-brown-and-zvonko-vranesic-fundamental-of-digital-logic-with-verilog-design.pdf		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Goran Benkek, lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Electromechanical and Electronic Converters</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">2nd</td><td>Semester</td><td colspan="3">3rd</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">20 + 25 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LEf</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>20</td><td>10</td><td>15</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquisition of basic knowledge about electromechanical and electronic converters.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Basics of electromechanical converters</td><td>O1</td><td colspan="5">Analyze the working principles and characteristics of electrical machines</td></tr>
<tr><td>O2</td><td colspan="5">Choose an electric machine according to the given operating requirements</td></tr>
<tr><td>O3</td><td colspan="5">Determine the mode of operation of the electric machine and the methods of regulating the working point of the machine</td></tr>
<tr><td rowspan="3">ULO2</td><td rowspan="3">Basics of electronic converters</td><td>O4</td><td colspan="5">Classify electronic converters according to the type of source and consumer</td></tr>
<tr><td>O5</td><td colspan="5">Select and parameterize the electronic converter according to the given requirements</td></tr>
<tr><td>O6</td><td colspan="5">Apply control and modulation methods using electronic controllers</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Conversions of mechanical and electrical energy (Outcome O1)
Electromagnetic induction, voltage generation, flow law. Energy image of the machine and signs of voltage, current and power.
2. Synchronous machine (Outcomes O2, O3)
Working principle and basic structural parts, start-up methods, application and operating modes.
3. Asynchronous machine (Outcomes O2, O3)
Principle of operation and basic structural parts, voltage equations and equivalent diagrams, no-load, short-circuit and load curves. Machine start-up methods. Single-phase motors.
4. DC machine (Outcomes O2, O3)</td></tr>
</table>

Principle of operation and performance of a DC machine, motor equations and schematic representation, electromechanical characteristics and operating modes.

5. **Servo and stepper motors** (Outcomes O2, O3)

Principle of operation, method of control and performance of the servo motor.

Principle of operation, control and performance of stepper motors.

6. **Electronic converters: classification and principles** (Outcome O4)

Types of electronic converters: AC-DC, DC-AC, DC-DC, AC-AC. Classification of converters according to the type of source and consumer. Basic principles of work and theoretical basis.

7. **Selection and parameterization of electronic converters** (Outcome O5)

The process of selecting electronic converters according to the given requirements. Parameterization and adjustment of converters for specific applications. Practical examples of selection and adjustment.

8. **Control and modulation methods in electronic controls** (Outcome O6)

Introduction to electronic converter control methods. Modulation techniques and management strategies. Practical applications and integration into management systems.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☐ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☐ other: flipped classroom

Students' obligations

- Full-time students must attend 4 out of 5 laboratory exercises.
- Part-time students must attend 3 out of 5 laboratory exercises.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Laboratory exercises	Thres-hold	Max
ULO1	O1	15%			7.5%	**15%**
	O2	15%			7.5%	**15%**
	O3	15%			7.5%	**15%**
ULO2	O4		15%		7.5%	**15%**
	O5		15%		7.5%	**15%**
	O6		15%		7.5%	**15%**
				10%	5%	**5%**
	Total	**45%**	**45%**	**10%**	**50%**	**100%**

The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome and on the laboratory exercises. Points earned on the

passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Written exam 1	Report from laboratory exercises	Thres-hold	Max
ULO1	O1	15%		7.5%	**15%**
	O2	15%		7.5%	**15%**
	O3	15%		7.5%	**15%**
ULO2	O4	15%		7.5%	**15%**
	O5	15%		7.5%	**15%**
	O6	15%		7.5%	**15%**
			10%	5%	**5%**
	Total	**90%**	**10%**	**50%**	**100%**

Learning outcomes that the student does not pass during the continuous assessment, will be taken during the exam period. The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome and laboratory exercises. If the student does not achieve a percentage of points in the laboratory exercises that is greater than or equal to the defined threshold, she or he submits a report that includes all laboratory exercises at the exam deadline. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Petrović, Igor: Electromechanical and electronic converters - Collection of solved problems, Technical College in Bjelovar, Bjelovar, 2015.	online	30
Benkek, Goran: “Presentation of lectures and exercises - Electromechanical and	online	30

electronic converters", the Bjelovar University of Applied Sciences		
Supplementary reading materials:		
J. Nađ, Electromechanical and electronic converters, University North, Varaždin, 2022 I.Flegar, Electronic power converters, Kigen, Zagreb, 2010 J. G. Kassakian, M. F. Schlecht, G. C. Verghese, Basics of Power Electronics, University of Zagreb, Zagreb, 2000 B. Skalicki, J. Grilec, Electric machines and drives, University of Zagreb, Zagreb, 2004		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Tomislav Pavlic, PhD, professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Additive Technologies</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">2nd</td><td>Semester</td><td colspan="3">3rd</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">15 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td colspan="2"></td><td>15</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquire and learn to use the knowledge necessary to understand, select and use additive technologies necessary for the development of new and modification of existing products within mechatronic systems.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="5">ULO1</td><td rowspan="5">Basic additive manufacturing procedures</td><td>O1</td><td colspan="5">Predict the possibility of applying additive manufacturing procedures</td></tr>
<tr><td>O2</td><td colspan="5">Generate 3D product model, layer information and physical model layers</td></tr>
<tr><td>O3</td><td colspan="5">Differentiate the processes of additive manufacturing of polymer products</td></tr>
<tr><td>O4</td><td colspan="5">Differentiate between the additive manufacturing processes of tools and metal products</td></tr>
<tr><td>O5</td><td colspan="5">Compare additive manufacturing processes</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">General about additive technologies. Properties and types of materials in additive technologies. 3D printing. 3D scanning. Reverse engineering. Digital production. Photogrammetry and object visualization. (Outcomes O1, O3, O4, O5)
Basics of software CAD tools for 2D and 3D modeling for the needs of additive technologies. Basics of programming tools for the needs of additive technologies. Modeling of parts with CAD software tools. Conversion of 3D models into industry standards of additive technologies in engineering and medicine. Preparation, use and integration of finished 3D models in CAD/CAM/CNC/AM systems. (Outcome O2)</td></tr>
<tr><td>Teaching formats</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ distance education</td><td colspan="4">☒ independent work
☐ multimedia and network
☒ laboratory
☐ mentor work</td></tr>
</table>

	☐ field course	☒ other: flipped classroom

Students' obligations

Attendance in accordance with the Study Regulations.
Creation of all defined tasks.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project	X	Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Project task	Thres-hold	Max
ULO1	O1	10%		5%	**10%**
	O2		60%	30%	**60%**
	O3	10%		5%	**10%**
	O4	10%		5%	**10%**
	O5	10%		5%	**10%**
	Total	**40%**	**60%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
Outcomes that the student does not pass during the continuous assessment, will be taken during the examination period.
Outcome O2 includes a project task in the field of additive technologies.

Exam term:

ULO	Outcomes	Written exam	Project task	Thres-hold	Max
ULO1	O1	10%		5%	**10%**
	O2		60%	30%	**60%**
	O3	10%		5%	**10%**
	O4	10%		5%	**10%**
	O5	10%		5%	**10%**
	Total	**40%**	**60%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
A passed learning outcome through continuous assessment or through the Exam term is "valid" for one calendar year, after which it is retaken.
Outcome O2 includes a project task in the field of additive technologies.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Pavlic, Tomislav: Lectures and exercises from course Additive technologies.	Online	30

Supplementary reading materials:

1. GODEC, Damir: Additive production / Damir Godec, Mladen Šercer - Zagreb : Faculty of Engineering and Naval Architecture, 2015 - IX, 193 p. : illustration ; 25 cm. - (Textbooks of the University of Zagreb)

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

GENERAL INFORMATION						
Lead instructor	Tomislav Pavlic, PhD, professional study program professor					
Course name	Machine Elements					
Study program	Professional undergraduate study program in Mechatronics					
Course status	Compulsory					
Year	2nd	**Semester**	3rd			
Credit value and teaching method	**Students' ECTS workload coefficient**	**3**				
	Classes total (L+E+S)*	15 + 25 + 0	L	E		S
				AE	LE	
			15	15	10	0

COURSE DESCRIPTION
Course objectives
Acquaint students with standardized elements of precision mechanics, calculation of elements of precision mechanics and materials from which individual elements are made. Acquaint students with power and motion transmitters and their basic calculations.
Conditions for enrollment into the course
Previously enrolled in the Fundamentals of Mechanics course 1.
Expected learning outcomes

Unit of learning outcomes		**Learning outcomes**	
ULO1	Analysis of elements of precision mechanics and machine elements	**O1**	Analyze the basic elements of precision mechanics
		O2	Analyze the basic elements of machines
		O3	Calculate the appropriate dimension, fit and tolerance of the shape and dimensions of standard elements of precision mechanics and machine elements
		O4	Calculate the stresses of standard elements of precision mechanics and machine elements

Course content
Basic terms. Normization (standardization). Allowable stresses. Division of elements of precision mechanics (elements of machines). Drawing of machine elements. Decomposable and non-decomposable compounds. Screws, nuts, washers. Hub joints. Connections with pins and bolts. Welded, soldered, riveted, clamped, glued joints. Other connection methods. Energy storage and resistors. Springs, weight, flywheel, pendulum, gyroscope, spacers, stops, brakes, chokes. Gaskets and sealing. Static sealing. Dynamic sealing. Motion transmission elements. Axles, shafts and sleeves. Lubricants. Sliding bearings. Roller bearings. Clutches. Carriers. Friction, belt, chain and gear transmissions. (Outcomes O1, O2, O3, O4).

Teaching formats		
	☒ lectures	☒ independent work
	☐ seminars and workshops	☐ multimedia and network
	☒ exercises	☐ laboratory
	☐ distance education	☐ mentor work
	☐ field course	☒ other: flipped classroom

Students' obligations							
Attendance in accordance with the Study Regulations. **Creation of all defined tasks.**							
Monitoring students' work							
Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Threshold	Max
ULO1	O1	25%		12.5%	**25%**
	O2	25%		12.5%	**25%**
	O3		25%	12.5%	**25%**
	O4		25%	12.5%	**25%**
	Total	**50%**	**50%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
Outcomes that the student does not pass during the continuous assessment, will be passed during the examination period.

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	25%	12.5%	**25%**
	O2	25%	12.5%	**25%**
	O3	25%	12.5%	**25%**
	O4	25%	12.5%	**25%**
	Total	**100%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
A passed learning outcome through continuous assessment or through the Exam term is "valid" for one calendar year, after which it is retaken.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade

0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Presentations from lectures and exercises from the course Elements of machines, the Bjelovar University of Applied Sciences.	online	30
Karl-Heinz Decker: Elements of machines, Tehnička knjiga, Zagreb, 2006.	9	30

Supplementary reading materials:

- Kraut, Bojan: Mechanics' manual, Tehnička knjiga, Zagreb.
- Group of authors: Kraut's engineering manual, Sajema, Zagreb, 2009.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td colspan="2">Lead instructor</td><td colspan="6">Zoran Vrhovski, PhD, professional study program professor</td></tr>
<tr><td colspan="2">Course name</td><td colspan="6">Fundamentals of Signals and Systems</td></tr>
<tr><td colspan="2">Study program</td><td colspan="6">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td colspan="2">Course status</td><td colspan="6">Compulsory</td></tr>
<tr><td colspan="2">Year</td><td colspan="2">2nd</td><td>Semester</td><td colspan="3">3rd</td></tr>
<tr><td colspan="2" rowspan="3">Credit value and teaching method</td><td colspan="2">Students’ ECTS workload coefficient</td><td colspan="5">3</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">15 + 20 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>15</td><td>20</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Introduce students to the analysis of continuous and discrete signals and systems and to the determination of system response using linear differential equations and transfer functions.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Previously enrolled course Mathematics 2.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="3">Unit of learning outcomes</td><td colspan="5">Learning outcomes</td></tr>
<tr><td rowspan="2">ULO1</td><td rowspan="2">Basics of analysis of continuous and discrete signals</td><td>O1</td><td colspan="5">Analyze continuous signals.</td></tr>
<tr><td>O2</td><td colspan="5">Analyze discrete signals.</td></tr>
<tr><td rowspan="2">ULO2</td><td rowspan="2">Basics of solving linear differential equations with constant coefficients of the first or second order</td><td>O3</td><td colspan="5">Solve a linear differential equation with constant coefficients of the first or second order</td></tr>
<tr><td>O4</td><td colspan="5">Apply the Laplace transform to solving a linear differential equation with constant coefficients of the first or second order</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Basic concepts (Outcome O1, O2)
Types of signals and systems. Continuous signals and systems. Discrete signals and systems. Basic signals.
Basic properties of signals and systems. Basic operations on signals.
2. Continuous systems (Outcomes O3, O4)
Description of the system by a linear differential equation with constant coefficients. Solving linear differential equations with constant coefficients. Block diagram of the system. The concept of convolutional integral. (Outcome O3)
Laplace transform. Basic properties of the Laplace transform. Application of the Laplace transform. Transfer function of a continuous system. Introduction to the Fourier transform. (Outcome O4)</td></tr>
</table>

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☐ laboratory ☐ mentor work ☐ other:

Students' obligations

- Attendance in accordance with the Study Regulations.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio		Home assignment	X				

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Home assignment	Mid-term exam	Threshold	Max
ULO1	O1	3%	15%	9%	**18%**
	O2	2%	12%	7%	**14%**
ULO2	O3	5%	33%	19%	**38%**
	O4	5%	25%	15%	**30%**
	Total	**15%**	**85%**	**50%**	**100%**

The student passed the course if he achieved a percentage of points that is greater than or equal to the defined Threshold on each learning outcome. Points earned on the passed Learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Reward points: It is possible to win reward points during the course. The student who solves the home assignment first and accurately will receive 2% bonus points. Reward points are linked to learning outcomes and are added to learning outcome points. The sum of all points on the learning outcome with reward points cannot exceed the maximum amount defined for the outcome.

Exam term:

ULO	Outcomes	Written exam	Threshold	Max
ULO1	O1	18%	9%	**18%**
	O2	14%	7%	**14%**
ULO2	O3	38%	19%	**38%**
	O4	30%	15%	**30%**
	Total	**100%**	**50%**	**100%**

Learning outcomes that the student does not pass during the continuous assessment, will be passed during the exam period

The student passed the course if he achieved a percentage of points that is greater than or equal to the defined Threshold on each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Vrhovski, Zoran; Purković, Dalibor: Signals and systems - Collection of solved tasks, Technical College in Bjelovar, Bjelovar, 2016. url:https://vub.hr/izdavastvo/knjiga/signali-i-sustavi-zbirka-rijesenih-zadataka-2.-izm.-izd	online	30
Vrhovski, Zoran: Lecture presentations from Signals and Systems, the Bjelovar University of Applied Sciences, Available on the Merlin e-learning system.	online	30

Supplementary reading materials:

Vrankić, Miroslav: Signals and systems - Collection of solved tasks, Graphis, Zagreb, 2007.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.

Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.

Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td colspan="2">Lead instructor</td><td colspan="6">Ivana Jurković, senior lecturer</td></tr>
<tr><td colspan="2">Course name</td><td colspan="6">Technical English</td></tr>
<tr><td colspan="2">Study program</td><td colspan="6">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td colspan="2">Course status</td><td colspan="6">Compulsory</td></tr>
<tr><td colspan="2">Year</td><td>2nd</td><td colspan="2">Semester</td><td colspan="2">3rd</td></tr>
<tr><td colspan="2" rowspan="3">Credit value and teaching method</td><td>Students’ ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">30 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td></td><td>30</td><td>30</td><td></td><td></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Train students to use the English language in the technical field.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="2">ULO1</td><td rowspan="2">Technical English</td><td>O1</td><td colspan="5">Use technical terminology in professional literature in English</td></tr>
<tr><td>O2</td><td colspan="5">Use simpler grammatical structures in English</td></tr>
<tr><td rowspan="2">ULO2</td><td rowspan="2">Written communication in the field of technical sciences in English</td><td>O3</td><td colspan="5">Write a summary of a professional text in English</td></tr>
<tr><td>O4</td><td colspan="5">Write an academic Essay on a topic from the field of technical sciences in English</td></tr>
<tr><td rowspan="2">ULO3</td><td rowspan="2">Professional grammar and specific technical English vocabulary</td><td>O5</td><td colspan="5">Integrate technical terminology into new contexts in English</td></tr>
<tr><td>O6</td><td colspan="5">Use more complex grammatical structures in English</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Reading: methods of working on professional texts and professional-scientific articles from the field of technical sciences with the aim of correct interpretation and active use of technical terminology (Outcome 1, Outcome 5)
2. Writing: summarizing information, simplifying technical content, adapting written content to the target audience, creating a summary of a professional text, types of academic Essays, creating an academic Essay on a topic from the field of technical sciences (Outcome 3, Outcome 4)
3. Listening: interpretation of video content in English on topics from the field of technical sciences with the aim of correct interpretation and active use of technical terminology (Outcome 1, Outcome 5)
4. Speech: oral presentation (monologue) on topics from the field of technical sciences, dialogue and discussion on topics from the field of technical sciences (Outcome 1, Outcome 5)
5. Vocabulary: interpretation and active use of technical terminology in written and oral form (Outcome 1, Outcome 5)</td></tr>
</table>

6. **Grammar**: simpler and more complex grammatical structures in the context of topics from the field of technical sciences (Outcome 2, Outcome 6)

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☐ laboratory ☐ mentor work ☐ other:

Students' obligations

- Attendance according to the Study Regulations.

Monitoring students' work

Attendance		Activity in class	X	Seminar paper		Experimental work	
Written exam	X	Oral exam	X	Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio	X						

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Portfolio	Threshold	Max
ULO1	O1	15			7.5	**15**
	O2	10			5	**10**
ULO2	O3		10		5	**10**
	O4		15		7.5	**15**
ULO3	O5			30	15	**30**
	O6			20	10	**20**
	Total	**25%**	**25%**	**50%**	**50%**	**100%**

The portfolio as part of the continuous assessment includes the regular creation and placement of completed assignments in the appropriate location on Merlin according to the defined plan that will be handed to the students at the introductory lecture, and active participation in the group discussion that includes an oral presentation of the contents of the portfolio in the defined exercise period. A student who does not achieve the minimum score threshold from the portfolio is obliged to take the oral exam. A student who achieves points equal to or higher than the threshold from the portfolio is exempt from taking the oral exam.

Through activities in class, students can earn an additional maximum of 10 points, which will be added to the points earned on Mid-term exams and the portfolio. Additional points are not added to any individual learning outcome, that is, the student must achieve the defined point threshold from all outcomes through the Mid-term exam, or portfolio. However, when the student passes all learning outcomes, additional points will be added and it is possible to achieve a higher grade based on them, whereby the maximum number of points cannot exceed 100. For example, if a student achieves a total of 92 points through

continuous testing and all 10 additional points, the total number of points will be 100, not 102. Additional points are valid as long as the passed learning outcomes according to the Assessment Regulations.

The student passed the course if he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Written exam	Oral exam	Threshold	Max
ULO1	O1	15		7.5	**15**
	O2	10		5	**10**
ULO2	O3	10		5	**10**
	O4	15		7.5	**15**
ULO3	O5		30	15	**30**
	O6		20	10	**20**
	Total	**50%**	**50%**	**50%**	**100%**

Learning outcomes that the student does not pass during the continuous assessment, will be passed during the exam period.
The student passed the course if he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Ibbotson, M. (2008.): *Cambridge English for Engineering*, Cambridge: Cambridge University Press	27	30

Jurković, I. (2024.): Teaching materials from the Technical English course (available online)	*online*	30
TED, https://www.ted.com/	*online*	30
Supplementary reading materials:		
Murphy, R. (2004.): *English Grammar in Use*, Cambridge: Cambridge University Press		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Zoran Vrhovski, PhD, professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Automated Controls</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td>2nd</td><td colspan="2">Semester</td><td colspan="4">4th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="6">6</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">30 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td colspan="2"></td><td>30</td><td>24</td><td>6</td><td></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Learn the elements of automation systems and the analysis and synthesis of continuous and time-invariant automatic control systems.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Previously enrolled in the Signals and Systems course.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Basics of automation system elements</td><td>O1</td><td colspan="5">Analyze the block diagram elements of a typical control circuit</td></tr>
<tr><td>O2</td><td colspan="5">Parameterize the automation element in accordance with the defined requirements</td></tr>
<tr><td>O3</td><td colspan="5">Calculate the transfer function of the automation element from its differential equation</td></tr>
<tr><td rowspan="5">ULO2</td><td rowspan="5">Analysis and synthesis of continuous and time-invariant automatic control systems</td><td>O4</td><td colspan="5">Analyze the time response of basic dynamic members</td></tr>
<tr><td>O5</td><td colspan="5">Sketch the transition function of basic automation elements</td></tr>
<tr><td>O6</td><td colspan="5">Analyze the frequency response of basic dynamic elements</td></tr>
<tr><td>O7</td><td colspan="5">Apply stability analysis procedures to continuous and time-invariant systems</td></tr>
<tr><td>O8</td><td colspan="5">Determine the structure and parameters of the regulator from the given quality indicators</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Basic terms and definitions (Outcome O1)
System classification. Linear time-invariant continuous systems. Basic structures of the management system.
2. Mathematical models of linear continuous systems (Outcome O3)
Description of linear systems by linear differential equations. Description of the system by the transfer function in the Laplace domain.
3. Algebra of blocks in the automatic control system (Outcome O1)</td></tr>
</table>

Block diagram of the system - basic elements. Series and parallel connected blocks. feedback Open and closed loop automatic control. The structure of the management system.

4. **Time response of the system of basic dynamic members** (Outcomes O2, O4, O5)

System response with regard to the position of the system poles (Outcome O4)

Time characteristics of basic dynamic members: P, PT1, PT2, PT2S I, D, DT1, member with transport delay (Outcomes O4, O5)

System quality indicators (Outcomes O4)

Parameterization of automation elements according to defined requirements in the time domain. (Outcome 2)

5. **Frequency response of basic dynamic members** (Outcome O6)

Nyquist and Bode diagram. Frequency characteristics of basic dynamic terms: P, PT1, PT2, PT2S I, D, DT1, term with transport delay.

6. **Analysis of the stability of the automatic control system** (Outcome O7)

Algebraic stability criteria: Hurwitz's stability criterion and Routh's stability criterion

Frequency stability criteria: Nyquist stability criterion and determination of stability using the Bode diagram

2. Synthesis of the control circuit of the automatic control system (Outcomes O8)

Requirements for the synthesis of automatic control systems. Basic structure of the automatic control system: Control system, Regulator, Actuator, Sensor. Parameterization of the basic versions of the controller using the Ziegler-Nichols method. Parameterization of the PI controller using the technical optimum method. Parameterization of the basic versions of the controller according to the defined time response requirements.

8. **Application of Matlab and Simulink software packages for analysis and synthesis of linear continuous automatic control systems** (Outcomes O1, O4, O6, O7, O8)

Analysis using the Matlab and Simulink software package: transfer functions, poles, zeros and gain of the system, algebra of blocks in the automatic control system, time and frequency response of the basic dynamic elements, stability of the automatic control system

Synthesis using the Matlab and Simulink software packages: parameterization of the basic versions of the controller using the Ziegler-Nichols method, parameterization of the PI controller using the technical optimum method.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☐ other:

Students' obligations

- Full-time students must attend 3 out of 3 laboratory exercises.
- Part-time students must attend 2 out of 3 laboratory exercises.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	

Portfolio		Home assignment	X				

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Home assignment	Mid-term exam 1	Mid-term exam 2	Thres-hold	Max
ULO1	O1	2%	12%		7%	**14%**
	O2	2%	12%		7%	**14%**
	O3		4%		2%	**4%**
ULO2	O4	2%	8%		5%	**10%**
	O5		6%		3%	**6%**
	O6		8%		4%	**8%**
	O7			14%	7%	**14%**
	O8	4%		26%	15%	**30%**
	Total	**10%**	**50%**	**40%**	**50%**	**100%**

The student passed the course if he achieved a percentage of points that is greater than or equal to the defined Threshold on each learning outcome. Points earned on the passed Learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Reward points: It is possible to win reward points during the course. The student who solves the home assignment first and accurately will receive 2% bonus points. Reward points are linked to learning outcomes and are added to learning outcome points. The sum of all points on the learning outcome with reward points cannot exceed the maximum amount defined for the outcome.

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	14%	7%	**14%**
	O2	14%	7%	**14%**
	O3	4%	2%	**4%**
ULO2	O4	10%	5%	**10%**
	O5	6%	3%	**6%**
	O6	8%	4%	**8%**
	O7	14%	7%	**14%**
	O8	30%	15%	**30%**
	Total	**100%**	**50%**	**100%**

Learning outcomes that the student does not pass during the continuous assessment, will be passed during the exam period. The student passed the course if he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Vrhovski, Zoran: Automatic control – Analysis and synthesis of linear continuous systems, Technical College in Bjelovar, Bjelovar, 2013, url: https://vub.hr/izdavastvo/knjiga/automatsko-upravajnan-analiza-i-sintez-linearnih - continuous-systems	online	30
Vrhovski, Zoran: Lecture presentations from Automatic control, available on the Merlin e-learning system.	online	30
Vrhovski, Zoran; Glumac, Slaven: Automatic control - a collection of solved problems, the Bjelovar University of Applied Sciences, available on the Merlin e-learning system.	online	30

Supplementary reading materials:

Crnošija, Petar; Bjažić, Toni: Basics of automation part I, Analysis and synthesis of continuous systems - theory and application, Element, Zagreb, 2011.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td colspan="2">Lead instructor</td><td colspan="6">Zoran Vrhovski, PhD, professional study program professor</td></tr>
<tr><td colspan="2">Course name</td><td colspan="6">Microcontrollers</td></tr>
<tr><td colspan="2">Study program</td><td colspan="6">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td colspan="2">Course status</td><td colspan="6">Compulsory</td></tr>
<tr><td colspan="2">Year</td><td colspan="2">2nd</td><td>Semester</td><td colspan="3">4th</td></tr>
<tr><td colspan="2" rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">5</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">15 + 40 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>15</td><td>10</td><td>30</td><td></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Apply microcontrollers in electronic devices and to create a functional microcontroller driver program for a given purpose in an electronic device.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Previously enrolled in the Basics of C programming language course.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="3">Unit of learning outcomes</td><td colspan="5">Learning outcomes</td></tr>
<tr><td rowspan="2">ULO1</td><td rowspan="2">Application of microcontrollers in electronic devices</td><td>O1</td><td colspan="5">Choose the optimal microcontroller for the given purpose by price, features and availability</td></tr>
<tr><td>O2</td><td colspan="5">Connect electronic devices to the microcontroller, taking care of the purpose of each pin of the microcontroller</td></tr>
<tr><td rowspan="4">ULO2</td><td rowspan="4">Microcontroller programming</td><td>O3</td><td colspan="5">Configure the operation of the microcontroller using registers for a given purpose</td></tr>
<tr><td>O4</td><td colspan="5">Create a microcontroller driver for a given purpose</td></tr>
<tr><td>O5</td><td colspan="5">Use microcontroller interrupt mechanisms when the functionality of the electronic device requires it</td></tr>
<tr><td>O6</td><td colspan="5">Test the microcontroller driver</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Basic concepts and structure of microcontroller (Outcome O1)
Microcontroller application. Historical development of microcontrollers. Differences between microcomputers, microcontrollers and microprocessors. Structure of the microcontroller. Microcontroller architectures. Execution of microcontroller instructions.
2. Microcontrollers (Outcomes O1, O3)
Microcontroller features. Microcontroller CPU. Operating cycle of the microcontroller. Execution of microcontroller instructions. Microcontroller instruction set. Microcontroller memory. Reset microcontroller sources. Microcontroller power supply. General purpose input/output registers. Digital outputs of the microcontroller. Digital inputs of the microcontroller. Analog-to-digital conversion and analog inputs of the microcontroller. Interrupt mechanisms of microcontrollers. Microcontroller counters and timers. Pulse width</td></tr>
</table>

modulation of the microcontroller. Microcontroller digital-to-analog converter. Universal asynchronous serial communication of microcontrollers. External microcontroller interrupts. Microcontroller watchdog timer. O2C communication. SPI communication. Sleep modes of operation and management of energy consumption of the microcontroller. Analog comparator microcontroller. Microcontroller manufacturers. Features of the AVR family of microcontrollers. Selecting a microcontroller for a given purpose.

3. **Microcontroller programming** (Outcomes O3, O4, O5, O6)

Microcontroller programming. AVR family microcontroller instruction set. Machine code. Main program and infinite loops. Intermittent routines. Functions. Programming environments for programming microcontrollers. Fuse bits. Lock bits. In-System Programming. Microcontroller program testing. Examples of good practice in microcontroller programming.

4. **Connecting electronic devices with a microcontroller** (Outcome O2)

Connecting electronic components to the microcontroller: buttons, LEDs, LCD display, potentiometer, NTC resistor, numerical display, optocoupler, transistor as switches, relay, buzzer, analog and digital temperature sensor, Bluetooth module, graphic display, GSM module, matrix keyboard, servo motor, ultrasonic sensor, Real time clock module, H bridge, communication module, rotary encoder, shift register, force sensor HX711. Control the microcontroller using an application on a computer or smartphone.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

- Full-time students must attend 8 out of 10 laboratory exercises.
- Part-time students must attend 7 out of 10 laboratory exercises.
- Creation a project task.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam		Oral exam	X	Essay		Research	
Project	X	Continuous knowledge assessment		Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Laboratory exercises	Project task	Oral exam	Thres-hold	Max
ULO1	O1		6%		3%	**6%**
	O2		10%		5%	**10%**
ULO2	O3		20%		10%	**20%**
	O4		20%		10%	**20%**
	O5		16%		8%	**16%**
	O6		8%		4%	**8%**
		10%			5%	**10%**
				10%	5%	**10%**
	Total	**10%**	**80%**	**10%**	**50%**	**100%**

During laboratory exercises, students write short tests in which it is necessary to collect a number of points that is greater than or equal to the defined threshold. Creating a project task is mandatory for every student. Project tasks are made independently or in teams of 2 to 4 students. The subject of the project task and the members of the team are agreed upon by the students with the course director. The student has passed the course if, through the project task, she or he has achieved a number of points that are greater than or equal to the defined threshold for each learning outcome, and if he has achieved the defined threshold in the oral exam and laboratory exercises. The student can take the oral exam if he has achieved the defined thresholds for each learning outcome and laboratory exercises. At the oral exam, the student must achieve the defined threshold, otherwise, during the exam period, he can only take the oral exam.
Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Project task	Oral exam	Thres-hold	Max
ULO1	O1	6%		3%	**6%**
	O2	10%		5%	**10%**
ULO2	O3	20%		10%	**20%**
	O4	20%		10%	**20%**
	O5	16%		8%	**16%**
	O6	8%		4%	**8%**
			20%	10%	**20%**
	Total	**80%**	**20%**	**50%**	**100%**

Creating a project task is mandatory for every student. Project tasks are made independently or in teams of 2 to 4 students. The subject of the project task and the members of the team are agreed upon by the students with the course director. The student has passed the course if, through the project task, she or he has achieved a number of points that are greater than or equal to the defined threshold for each learning outcome, and if she or he has achieved the defined threshold in the oral exam and laboratory exercises. The student can take the oral exam if she or he has achieved the defined thresholds for each learning outcome and laboratory exercises. At the oral exam, the student must achieve the defined threshold, otherwise, during the exam period, she or he can only take the oral exam.
Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course		
Title	Number of copies	Number of students
Zoran Vrhovski: MICROCONTROLLERS - Programming of AVR family microcontrollers, the Bjelovar University of Applied Sciences, 2020, Bjelovar, url: https://vub.hr/izdavastvo/knjiga/mikroupravljaci	online	30
Zoran Vrhovski: Lecture presentations from Microcontrollers, the Bjelovar University of Applied Sciences, available on the e-learning system Merlin	online	30
Microchip: 8-bit Microcontroller with 16/32K bytes of ISP Flash and USB Controller – ATmega16U4/ATmega32U4, https://www.microchip.com/wwwproducts/en/ATmega32u4 (available at: 24 Nov 2023)	online	30
Supplementary reading materials:		
F. Barrett, Steven.; Pack, Daniel; Thornton, Mitchell: Atmel AVR microcontroller primer: programming and interfacing, Morgan &ClaypoolPublishers, Thornton, 2007. Vrhovski, Zoran; Miletić, Marko: Microcomputers - Programming microcontrollers of the Atmel family in the programming environment Atmel Studio 6, Technical College in Bjelovar, Bjelovar, 2014. url: https://vub.hr/izdavastvo/knjiga/mikroracunala-programiranje-mikrokontrolera-porodice-atmel-u-programskom - ok		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Tomislav Pavlic, PhD, professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Fundamentals of Mechanisms</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">2nd</td><td>Semester</td><td colspan="3">4th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">15 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td colspan="2"></td><td>15</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquire and learn to use the knowledge needed to understand, select, modify, adapt to one's own needs, and use different types of mechanisms for the needs of mechatronic systems.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Previously enrolled courses Technical documentation of mechatronic system and Fundamentals of Mechanics 2.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="5">ULO1</td><td rowspan="5">Basic types of mechanisms: analysis, dimensional synthesis and construction</td><td>O1</td><td colspan="5">Classify basic types of mechanisms</td></tr>
<tr><td>O2</td><td colspan="5">Analyze the kinematics of basic types of mechanisms</td></tr>
<tr><td>O3</td><td colspan="5">Analyze the dynamics of basic types of mechanisms</td></tr>
<tr><td>O4</td><td colspan="5">Carry out a dimensional synthesis of the basic types of mechanisms according to the given specification</td></tr>
<tr><td>O5</td><td colspan="5">Design basic types of mechanisms according to the given specification</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">Introduction to the theory of mechanisms. Structure and classification of mechanisms. Mechanism members. Kinematic couples. Kinematic chains. Degrees of freedom of movement. Structure and classification of mechanisms. Methods and procedures for designing realistic mechanisms. Basic types of mechanisms. Mechanisms driven by electric motors, pneumatic and hydraulic (Outcome O1).
Kinematic analysis of mechanisms in tools for the development of real mechanisms. Kinematic characteristics of the laws of motion. Kinematics of the driving and working members of the mechanism. Dimensioning of mechanisms. Selection and adaptation of real mechanical and electrical components for the performance of different types of mechanisms (Outcome O2, O3, O4).
Procedures for making mechanisms. Designing mechanisms with different kinematics and driven by different drives, used in mechatronic systems (Outcome O5).</td></tr>
<tr><td colspan="2">Teaching formats</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises</td><td colspan="2">☒ independent work
☐ multimedia and network
☒ laboratory</td></tr>
</table>

	☐ distance education ☐ field course	☐ mentor work ☒ other: flipped classroom

Students' obligations

Attendance in accordance with the Study Regulations.
Creation of all defined tasks.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project	X	Continuous knowledge assessment	X	Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Project task	Thres-hold	Max
ULO1	O1	10%		10%	10%	**20%**
	O2	10%		10%	10%	**20%**
	O3		10%	10%	10%	**20%**
	O4		10%	10%	10%	**20%**
	O5		10%	10%	10%	**20%**
	Total	**20%**	**30%**	**50%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
Outcomes that the student does not pass during the continuous assessment, will be passed during the examination period.
Outcomes are all included in the project task that the student should create.

Exam term:

ULO	Outcomes	Written exam	Project task	Thres-hold	Max
ULO1	O1	10%	10%	10%	**20%**
	O2	10%	10%	10%	**20%**
	O3	10%	10%	10%	**20%**
	O4	10%	10%	10%	**20%**
	O5	10%	10%	10%	**20%**
	Total	**50%**	**50%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
A passed learning outcome through continuous assessment or through the Exam term is "valid" for one calendar year, after which it is retaken.

Outcomes are all included in the project task that the student should create.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Pavlic, Tomislav: Lectures and exercises from the Mechanisms course, the Bjelovar University of Applied Sciences.	online	30

Supplementary reading materials:

- Husnjak, M.: Theory of Mechanisms, Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, 2003.
- Hagedorn, L., Thonfeld, W. and Rankers A.: Konstruktive Getriebelehre, Springer-Verlag, Berlin Heidelberg, 2009.
- Bazjanac, D.: Basics of the theory of mechanisms, Zagreb, 1966.
- Muftić, O., Drača, K.: Introduction to the theory of mechanisms, University Press Liber, Zagreb, 1974.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
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Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Stjepan Golubić, PhD, adjunct professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Maintenance of Mechatronic Systems</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">2nd</td><td>Semester</td><td colspan="3">4th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">30 + 15 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td colspan="2"></td><td>30</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquire basic knowledge about the organization, technology and concept of maintenance of mechatronic systems.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="6">ULO1</td><td rowspan="6">Basics of maintenance of mechatronic systems</td><td>O1</td><td colspan="5">Define the main functions and basic tasks of maintenance of mechatronic systems</td></tr>
<tr><td>O2</td><td colspan="5">Identify the most common causes of downtime and failures of mechatronic systems</td></tr>
<tr><td>O3</td><td colspan="5">Analyze methods and approaches to the maintenance of mechatronic systems</td></tr>
<tr><td>O4</td><td colspan="5">the reliability of mechatronic systems</td></tr>
<tr><td>O5</td><td colspan="5">Propose technological processes of preventive maintenance of mechatronic systems</td></tr>
<tr><td>O6</td><td colspan="5">Propose a strategy for the maintenance of mechatronic systems</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Basic concepts from the theory of maintenance of mechatronic systems. (Outcome O1).
2. Tasks in the maintenance of mechatronic systems. (Outcome O1).
3. Stoppages and their importance, collection and processing of data on stoppages (Outcome O2).
4. Causes of downtime and failures of mechatronic systems. (Outcome O2).
5. Methods and approaches to maintenance (Outcome O3).
6. Theoretical aspects of maintenance (Outcome O3).
7. Planning of maintenance works (Outcome O3).
8. Reliability of mechatronic systems, reliability calculation of mechatronic systems (Outcome O4).
9. Preventive maintenance of mechatronic systems (Outcome O5)
10. Maintenance strategies (Outcome O6).
11. The problem of stock of spare parts for maintenance purposes (Outcome O6).</td></tr>
</table>

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☐ independent work ☐ multimedia and network ☐ laboratory ☐ mentor work ☐ other: flipped classroom

Students' obligations

- Attending lectures and auditory exercises according to the Study Regulations.

Monitoring student's work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Mid-term exam 3	Thres-hold	Max
ULO1	O1	15%			7.5%	**15%**
	O2	15%			7.5%	**15%**
	O3	20%			10%	**20%**
	O4		15%		7.5%	**15%**
	O5		15%		7.5%	**15%**
	O6		20%		10%	**20%**
	Total	**50%**	**50%**		**50%**	**100%**

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	15%	7.5%	**15%**
	O2	15%	7.5%	**15%**
	O3	20%	10%	**20%**
	O4	15%	7.5%	**15%**
	O5	15%	7.5%	**15%**
	O6	20%	10%	**20%**
	Total	**100%**	**50%**	**100%**

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)

50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
• Kondić, Živko; Čikić, Ante; Kondić, Veljko: Basics of maintenance of mechatronic systems 1, Technical College in Bjelovar, Bjelovar, 2014.	10	30

Supplementary reading materials:

Group of authors; Property maintenance and management (ESUO manual), Croatian maintenance company, Zagreb, 2016.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

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Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Stjepan Golubić, PhD, adjunct professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Quality Management</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">2nd</td><td>Semester</td><td colspan="4">4th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="6">3</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">15 + 15 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquire knowledge about the basics of quality, the application of quality management in modern production, and modern views and approaches to quality assurance.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="5">ULO1</td><td rowspan="5">Basics of the quality assurance system</td><td>O1</td><td colspan="5">Recognize the importance of the quality of products and services in modern production</td></tr>
<tr><td>O2</td><td colspan="5">Analyze quality assurance methods</td></tr>
<tr><td>O3</td><td colspan="5">Analyze the structure of the quality assurance system based on the standards applied in the industry</td></tr>
<tr><td>O4</td><td colspan="5">Make an analysis for product quality control</td></tr>
<tr><td>O5</td><td colspan="5">Apply basic tools to improve product quality</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Concept of quality and quality control (Outcome O1)
2. Contemporary views on quality (Outcome O1)
3. Presentation of the quality control function (Outcome O1)
4. Principles of quality (Outcome O1)
5. Quality improvement policy and goals (Outcome O2)
6. Basic methods in quality control systems (Outcome O2)
7. New methods in quality control systems (Outcome O2)
8. Systematization of quality control methods (Outcome O2)
9. Contemporary conception and organization of quality control (Outcome O3)
10. Organizational and technical assumptions of the quality control function (Outcome O3)
11. Norms for quality assurance in industry (Outcome O3)
12. Metrology in the function of quality assurance (Outcome O4)
13. Controls in the quality management system (Outcome O4)
14. Improvements in the quality management system (Outcome O5)</td></tr>
</table>

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☐ independent work ☐ multimedia and network ☐ laboratory ☐ mentor work ☐ other: flipped classroom

Students' obligations

- Attending lectures and auditory exercises according to the Study Regulations.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Mid-term exam 3	Thres-hold	Max
ULO1	O1	15%			7.5%	
	O2	25%			12.5%	
	O3		20%		10%	
	O4		20%		10%	
	O5		20%		10%	
	Total	**40%**	**60%**		**50%**	

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	15%	7.5%	**15%**
	O2	25%	12.5%	**25%**
	O3	20%	10%	**20%**
	O4	20%	10%	**20%**
	O5	20%	10%	**20%**
	Total	**100%**	**50%**	**100%**

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)

75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Kondić, Živko; Čikić, Ante: Quality management in mechatronics, Technical College in Bjelovar, Bjelovar, 2012.	14	30

Supplementary reading materials:

Kondić Živko: Statistical quality control, University of Varaždin, Varaždin, 2012.
Kondić, Živko; Maglić, Leon; Pavletić, Duško; Samardžić, Ivan: Quality 1, J.J. Strossmayer University in Osijek, University of the North, University of Rijeka, Varaždin, 2018.
Kondić, Živko; Maglić, Leon; Pavletić, Duško; Samardžić, Ivan: Quality 2, J. J. Strossmayer University in Osijek, University North, University of Rijeka, Varaždin, 2018.
Kondić, Živko; Maglić, Leon; Pavletić, Duško; Samardžić, Ivan: Quality 3, University of J. J. Strossmayer in Osijek, University of the North, University of Rijeka, Varaždin, 2018.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

GENERAL INFORMATION							
Lead instructor	Adela Zobundžija, adjunct lecturer						
Course name	Business Planning						
Study program	Professional undergraduate study program in Mechatronics						
Course status	Compulsory						
Year	2nd		**Semester**	4th			
Credit value and teaching method	**Students' ECTS workload coefficient**	**4**					
	Classes total (L+E+S)*	15 + 15 + 15	L	E		S	
				AE	LE		
			15	15	0	15	

COURSE DESCRIPTION			
Course objectives			
The objective of the course is to practically apply and evaluate the acquired knowledge by identifying and recognizing the independent application of the content, form and techniques of preparing a business plan, focusing on planning in micro and small enterprises, regardless of the choice of activity.			
Conditions for enrollment into the course			
Equal to the conditions for access to obtaining the qualification.			
Expected learning outcomes			
Unit of learning outcomes		**Learning outcomes**	
ULO1	Basics of business planning for students of engineering studies	**O1**	Analyze the business and general environment as a basis for the preparation and development of business plans
		O2	Conceptualize the basic elements of a company's strategy while choosing a legal business model
		O3	Develop important parts of a complete business plan and the content and process of business planning with tactical and operational implementation plans
		O4	Explain Project management methods and techniques and the Project life cycle
		O5	Create a professionally acceptable business plan for different groups of potential users
		O6	Apply program support for business planning and project development
Course content			
1. 1. Introduction to business planning - needs, goals and tasks of a modern company; types of business plans and their purpose; basic elements and methodology of creating business plans (3P) (O1) 2. Business strategies and selection of legal business operations of the company - development goals of the company, methodology and processes, planning techniques, principle of assessment and selection of business models according to activities (3P+3V) (O2) 3. Principles of creating a business plan - market analysis, organizational and technical conditions and development, financing,			

marketing and defining the necessary resources; Project management - characteristics, life cycle, methods and techniques; tactical and operational plans; (3P +3V) (O3)

4. Selection of the planning area and the practical task of creating a company's business plan Independent creation of a plan with all elements, financing with projection of business results, evaluation efficiency, sensitivity/risk analysis of business; Presentation of results and presentation of works; similarities and differences of business plan vs. investment studies and their application in practice (3P+6V) (O4)
5. Application of software tools in business planning, implementation of projects and budgeting, and research markets; available applications for creating business plans, cost sheets and budgeting (3P+3V) (O5)
6. Practical task of business plan created and presented through Seminar paper on the example of a virtual companies in growth and business development; Allowed to work in groups (15S) (O6)

Teaching formats	☒ lectures ☒ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☐ laboratory ☐ mentor work ☐ other: flipped classroom

Students' obligations

- Full-time students must attend minimum 70% of classes
- Part-time students must attend minimum 50% of classes
- Mandatory creation and submission of a business plan with a presentation of the results

Monitoring students' work

Attendance		Activity in class		Seminar paper	X	Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Mid-term exam 3	Thres-hold	Max
ULO1	O1	10%			5%	10%
	O2	20%			10%	20%
	O3	20%			10%	20%
	O4		10%		5%	10%
	O5		20%		10%	20%
	O6		20%		10%	20%
	Total	**50%**	**50%**		**50%**	**100%**

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	10%	5%	10%
	O2	20%	10%	20%

	O3	20%	10%	20%
	O4	10%	5%	10%
	O5	20%	10%	20%
	O6	20%	10%	20%
	Total	**100%**	**50%**	**100%**

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Kolaković, M. (2020) Entrepreneurship in the 21st century, Student Incubator, Zagreb	5	30

Supplementary reading materials:

- Ribić D., Pleša Puljić, N. (2020) Basics of entrepreneurship, Zagreb, Školska knjiga
- Bobera, D., Hunjet. A., Kozina, G. (2015) Entrepreneurship, Varaždin, University North

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Ivana Jurković, senior lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Business English</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td>2nd</td><td colspan="2">Semester</td><td colspan="3">4th</td></tr>
<tr><td rowspan="2">Credit value and teaching method</td><td>Students' ECTS workload coefficient</td><td colspan="6">4</td></tr>
<tr><td>Classes total (L+E+S)*</td><td>30 + 30 + 0</td><td>L</td><td colspan="2">E</td><td>S</td></tr>
<tr><td></td><td></td><td></td><td>AE</td><td>LE</td><td></td></tr>
<tr><td></td><td></td><td></td><td>30</td><td>30</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The objective of the course is to teach students how to use business English.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Basic use of business English</td><td>O1</td><td colspan="5">Achieve business communication by e-mail in English</td></tr>
<tr><td>O2</td><td colspan="5">Create a resume and job application in internationally accepted formats in English</td></tr>
<tr><td>O3</td><td colspan="5">Use business names and phrases in English</td></tr>
<tr><td rowspan="2">ULO2</td><td rowspan="2">Presentation of a topic from the field of technical sciences in English</td><td>O4</td><td colspan="5">Create a structured presentation in English on a topic from the technical field</td></tr>
<tr><td>O5</td><td colspan="5">Present a topic from the technical field in English</td></tr>
<tr><td rowspan="2">ULO3</td><td rowspan="2">Independent use of business English</td><td>O6</td><td colspan="5">in written and oral form about everyday business topics and situations in English</td></tr>
<tr><td>O7</td><td colspan="5">Integrate business names and phrases into new contexts in English</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Reading: methods of working on business texts with the aim of correct interpretation and active use of business terms and phrases (Outcome 3, Outcome 6, Outcome 7)
2. Writing: business communication by e-mail, creating resumes and job applications, creating a structured presentation (Outcome 1, Outcome 2, Outcome 4)
3. Listening: interpretation of the video content of recorded presentations in English with the aim of critically reflecting on the preparation for one's own presentation and on everyday business topics and situations (Outcome 4, Outcome 6)
4. Speech: presentation of a technical topic, telephone conversation, video conference, small talk in a business environment, concise presentation (elevator pitch) (Outcome O5, Outcome 6, Outcome 7)</td></tr>
</table>

5. **Vocabulary**: interpretation and active use of business terminology in written and oral form (Outcome 3, Outcome 7)
6. **Grammar**: specific grammatical structures when writing official e-mails (Outcome 1)

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☐ laboratory ☐ mentor work ☐ other:

Students' obligations

- Attendance according to the Study Regulations.
- Presentation performed in front of the group in the previously defined exercise time.

Monitoring students' work

Attendance		Activity in class	x	Seminar paper		Experimental work	
Written exam	x	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	x	Report		Practical work	
Portfolio	x	Presentation	x				

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam	Portfolio	Presen-tation	Thres-hold	Max
ULO1	O1	10			5	**10**
	O2		10		5	**10**
	O3	30			15	**30**
ULO2	O4		5		2,5	**5**
	O5			20	10	**20**
ULO3	O6		15		7.5	**15**
	O7		10		5	**10**
	Total	**40**	**40**	**20**	**50%**	**100%**

The portfolio as part of the continuous assessment includes the regular creation and placement of completed tasks in the appropriate location on Merlin according to the defined plan that will be handed to the students at the introductory lecture. The portfolio must be completed no later than one day before the exam deadline that the student applies for.

The presentation is mandatory and, as a rule, it must be performed in front of the group in a pre-defined exercise time.

Through class activities, students can earn an additional maximum of 10 points, which will be added to the points earned on the Mid-term exam, portfolio and presentation. Additional points are not added to any individual learning outcome, that is, the student must achieve the defined point threshold from all outcomes through the Mid-term exam, i.e. portfolio and presentation. However, when the student passes

all learning outcomes, additional points will be added and it is possible to achieve a higher grade based on them, whereby the maximum number of points cannot exceed 100. For example, if a student achieves a total of 92 points through continuous testing and all 10 additional points, the total number of points will be 100, not 102. Additional points are valid as the duration of the passed learning outcomes according to the Assessment Regulations.

The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome.

Exam term:

ULO	Outcomes	Written exam	Portfolio	Presen-tation	Thres-hold	Max
ULO1	O1	10			5	**10**
	O2		10		5	**10**
	O3	30			15	**30**
ULO2	O4		5		2,5	**5**
	O5			20	10	**20**
ULO3	O6		15		7.5	**15**
	O7		10		5	**10**
	Total	**40**	**40**	**20**	**50%**	**100%**

Learning outcomes that the student does not pass during the continuous assessment, will be passed during the exam period. The student passed the course if she or he achieved a percentage of points that is greater than or equal to the defined threshold on each learning outcome.
Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Kazamia, V., Jurković, I., Badrov, T. (2022.): *Soft Skills for Engineering Students*, Project BADGE (available *online*)	*Online*	70

Badrov T., Carvalho A., Jurković I., Kazamia V. (2021). *Intercultural Communication and Linguistic Upgrade in a Digital Environment*. Bjelovar: the Bjelovar University of Applied Sciences (available *online*)	*Online*	70
Jurković, I. (2024.): Teaching materials from the course Business English (available *online*)	*Online*	70
TED, https://www.ted.com/	*Online*	70
Supplementary reading materials:		
Trappe, T., Tullis, G. (2013.): *Intelligent Business Coursebook – Advanced Business English*, 2nd Edition, Essex: Paerson Education Limited		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Zoran Vrhovski, PhD, professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Automation Fundamentals</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">5th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">6</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">30 + 30 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Introduce students to the automation of industrial processes using PLC devices, industrial protocols and the SCADA system.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="2">ULO1</td><td rowspan="2">Connecting the selected programmable logic controller with process automation devices</td><td>O1</td><td colspan="5">Select the programmable logic controller with expansion modules for the purpose of process automation</td></tr>
<tr><td>O2</td><td colspan="5">Connect process automation devices with programmable logic controller and expansion modules</td></tr>
<tr><td rowspan="5">ULO2</td><td rowspan="5">Programmable Logic Controller Programming</td><td>O3</td><td colspan="5">Configure the programmable logic controller and/or expansion modules</td></tr>
<tr><td>O4</td><td colspan="5">Apply the IEC 61131-3 standard for programming a programmable logic controller</td></tr>
<tr><td>O5</td><td colspan="5">Structure the program of the programmable logic controller</td></tr>
<tr><td>O6</td><td colspan="5">Create a programmable logic controller driver for simpler automation processes</td></tr>
<tr><td>O7</td><td colspan="5">Test the driver by commissioning the programmable logic controller</td></tr>
<tr><td rowspan="3">ULO3</td><td rowspan="3">Basics of industrial protocols and SCADA systems</td><td>O8</td><td colspan="5">Implement an appropriate industrial protocol for the exchange of information between a programmable logic controller and the SCADA system</td></tr>
<tr><td>O9</td><td colspan="5">Create tags to transfer data from a programmable logic controller to a SCADA system using an arbitrary industrial protocol</td></tr>
<tr><td>O10</td><td colspan="5">Create a SCADA system for simpler processes</td></tr>
<tr><td colspan="8">Course content</td></tr>
</table>

1. Basic terms and definitions

Basic terms in automation. Historical development of PLC devices. The role and significance of PLC in industry.

2. **Programmable logic controllers** (Outcome O1)

The principle of PLC operation. PLC architecture (CPU, power supply, digital inputs and outputs, analog inputs and outputs). Schneider Electric PLC devices. Modules for expansion of digital/analog inputs and outputs.

3. **Sensors and actuators in industrial automation** (Outcome O2)

Connecting digital and analog sensors to the PLC device. Connecting the actuator to the PLC device.

4. **CODESYS platform for industrial automation and standard IEC 61131-3** (Outcomes O3, O4, O5, O6, O7)

Configuring the PLC device (Outcome 3)

Standard IEC 61131-3: Program structure. Variables, Identifiers. Keywords. Comments. Data types. Addressing. Programming languages in standard IEC 61131-3: Ladder diagram (LD). Function block diagram (FBD). Structured text (ST). Instruction sheet (IL). Sequential function chart (SFC). CODESYS platform: Continuous Function Chart (CFC) programming language.

Functions/operators: Logical functions/operators. Arithmetic functions/operators. Data type conversions. Bit Shift Operators. Selection functions/operators. Comparison functions/operators. Numerical functions.

Function blocks: Edge detection. Bistables. Timers (TON, TOF, TP). Counters.

Other functions and function blocks. (Outcomes O4, O6)

Software development environment for programming PLC devices. Structuring the PLC device program. (Outcomes O5)

Examples of PLC device driver programs for simpler automation processes (Outcome O6)

Testing of the control program of the PLC device and commissioning. (Outcome O7)

5. **Industrial communication networks and protocols** (Outcome O8)

Hierarchy of communication network in industry: Factory network, process network, Sensor-actuator network. Industrial communication networks and protocols: Fieldbus and Industrial Ethernet, Modbus, OPC UA, EtherNet/IP. An example of the implementation of industrial protocols.

6. **SCADA systems** (Outcomes O9, O10)

Fundamentals of systems for collecting, processing and displaying data in industrial automation (SCADA). Tags. Visualization. Trends. Alarms. Software development environment for creating SCADA systems. HMI (Outcome 10)

Creation of tags (Outcome 9).

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

- Full-time students must attend 8 out of 10 laboratory exercises.
- Part-time students must attend 7 out of 10 laboratory exercises.
- Creation of a project task.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam		Oral exam	X	Essay		Research	
Project	X	Continuous knowledge assessment		Report		Practical work	X

Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Laboratory exercises	Project task	Oral exam	Thres-hold	Max
ULO1	O1		6%		3%	**6%**
	O2		8%		4%	**8%**
ULO2	O3		6%		3%	**6%**
	O4		12%		6%	**12%**
	O5		6%		3%	**6%**
	O6		12%		6%	**12%**
	O7		6%		3%	**6%**
ULO3	O8		8%		4%	**8%**
	O9		8%		4%	**8%**
	O10		12%		6%	**12%**
		10%			5%	**10%**
				6%	3%	**6%**
	Total	**10%**	**84%**	**6%**	**50%**	**100%**

During laboratory exercises, students write short tests in which it is necessary to collect a number of points that is greater than or equal to the defined threshold. Creating a project task is mandatory for every student. Project tasks are made independently or in teams of 2 to 4 students. The subject of the project task and the members of the team are agreed upon by the students with the course instructor. The student passed the course if, through the project task, he achieved a number of points that are greater than or equal to the defined threshold for each learning outcome, and if he achieved the defined threshold in the oral exam and laboratory exercises. The student can take the oral exam if she or he has achieved the defined threshold for each learning outcome and laboratory exercises. At the oral exam, the student must achieve the defined threshold, otherwise, during the exam period, she or he can only take the oral exam. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Project task	Oral exam	Thres-hold	Max
ULO1	O1	6%		3%	**6%**
	O2	8%		4%	**8%**
ULO2	O3	6%		3%	**6%**
	O4	12%		6%	**12%**
	O5	6%		3%	**6%**
	O6	12%		6%	**12%**
	O7	6%		3%	**6%**
ULO3	O8	8%		4%	**8%**
	O9	8%		4%	**8%**
	O10	12%		6%	**12%**
				5%	**10%**
			16%	8%	**16%**
	Total	**84%**	**16%**	**50%**	**100%**

Creating a project task is mandatory for every student. Project tasks are made independently or in teams of 2 to 4 students. The subject of the project task and the members of the team are agreed upon by the students with the course instructor. The student has passed the course if, through the project task, he has achieved a number of points that are greater than or equal to the defined threshold for each learning outcome, and if he has achieved the defined threshold in the oral exam. The student can take the oral exam if he has achieved the defined threshold for each learning outcome and laboratory exercises. At the oral exam, the student must achieve the defined threshold, otherwise, at the next exam period, she or he can only take the oral exam (except in the case of the 4th or 8th time taking the exam - in that case, the achieved points according to learning outcomes are reset). Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Vrhovski, Zoran: Presentations from lectures and exercises from Computer guidance and process management, the Bjelovar University of Applied Sciences, Bjelovar, Available on the Merlin e-learning system.	online	30
Howlett, Bruce: Getting Started With SoMachine Self Study Manual - SoMachineVer 4.1.1, Schnider Electric, 2015.	online	30

Supplementary reading materials:

Hanssen, Dag Hâkon: Programmable Logic Controllers: A Practical Approach to IEC 61131-3 using CODESYS, John Wiley&Sons, Ltd, United Kingdom, 2015.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Tomislav Pavlic, PhD, professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Pneumatics and Hydraulics</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">2nd</td><td>Semester</td><td colspan="3">5th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">5</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">30 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td colspan="2"></td><td>30</td><td>10</td><td>20</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquaint students with the application of pneumatics, electropneumatics, hydraulics and electrohydraulics.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="4">ULO1</td><td rowspan="4">Application of pneumatics and electropneumatics in automation</td><td>O1</td><td colspan="5">Analyze the operation of pneumatic and electropneumatic components and systems</td></tr>
<tr><td>O2</td><td colspan="5">Choose pneumatic and electropneumatic components for the given purpose</td></tr>
<tr><td>O3</td><td colspan="5">Automate the system using pneumatic and electropneumatic components</td></tr>
<tr><td>O4</td><td colspan="5">Create pneumatic and electropneumatic system diagrams</td></tr>
<tr><td rowspan="3">ULO2</td><td rowspan="3">Application of hydraulics and electrohydraulics in automation</td><td>O5</td><td colspan="5">Analyze hydraulic, electrohydraulic, proportional and servohydraulic components and systems</td></tr>
<tr><td>O6</td><td colspan="5">Simulate an automated system using hydraulic and electrohydraulic components</td></tr>
<tr><td>O7</td><td colspan="5">Create hydraulic and electro-hydraulic schemes of the system</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">Basic concepts of pneumatics. Compressed air supply and distribution system. Preparation of compressed air. Pneumatic executive elements. Pneumatic control elements. Methods of pneumatic control. Special pneumatic elements. Pneumatic control. Electropneumatics. Maintenance of pneumatic systems (Outcomes O1, O2, O3, O4).
Basic concepts of hydraulics. Hydraulic elements. Hydraulic executive elements. Hydraulic control elements. Electrohydraulics. Proportional hydraulics. Servohydraulics Maintenance of hydraulic systems (Outcomes O5, O6, O7).</td></tr>
<tr><td colspan="2">Teaching formats</td><td colspan="3">☒ lectures
☐ seminars and workshops</td><td colspan="3">☒ independent work
☐ multimedia and network</td></tr>
</table>

	☒ exercises ☐ distance education ☐ field course	☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

Attendance in accordance with the Study Regulations.
Creation of all defined tasks.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project	X	Continuous knowledge assessment	X	Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Project task	Thres-hold	Max
ULO1	O1	10%			5%	**10%**
	O2	10%			5%	**10%**
	O3	10%			5%	**10%**
	O4	10%		20%	15%	**30%**
ULO2	O5		10%		5%	**10%**
	O6		10%		5%	**10%**
	O7		10%	10%	10%	**20%**
	Total	**40%**	**30%**	**30%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
Outcomes that the student does not pass during the continuous assessment, will be passed during the examination period.
Project task refers to the creation of a practical task on real equipment from the field of pneumatics, electropneumatics, hydraulics or electrohydraulics.

Exam term:

ULO	Outcomes	Written exam	Project task	Thres-hold	Max
ULO1	O1	10%		5%	**10%**
	O2	10%		5%	**10%**
	O3	10%		5%	**10%**
	O4	10%	20%	15%	**30%**
ULO2	O5	10%		5%	**10%**
	O6	10%		5%	**10%**
	O7	10%	10%	10%	**20%**
	Total	**70%**	**30%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
A passed learning outcome through continuous assessment or through the exam term is "valid" for one calendar year, after which it is retaken.
Project task refers to the creation of a practical task on real equipment from the field of pneumatics, electropneumatics, hydraulics or electrohydraulics.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Pavlic, Tomislav: Lectures and exercises from course Pneumatics and hydraulics, the Bjelovar University of Applied Sciences.	online	30
Nikolić, Gojko: Pneumatics and hydraulics, Part I PNEUMATICS, Školske novine, Zagreb 2005.	5	30
Nikolić, Gojko; Novaković, Jakša.: Pneumatics and hydraulics, Part II PNEUMATICS, Školske novine, Zagreb 2003.	5	30

Supplementary reading materials:

- Maleš, N.: Pneumatics and hydraulics worksheets, Center for new technologies, Zagreb 2014.
- Koroman, V., Mirković, R.: Hydraulics and pneumatics, Školska knjiga, Zagreb 1991.
- Maleš, Neven: Electropneumatics, Festo, Zagreb 2008..
- Maleš, Neven: Proportional hydraulics, Festo, Zagreb 2011.
- Catalogs and brochures: Festo, Linde, Danfos, Bosch-Rexroth, Parker and others.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Tomislav Pavlic, PhD, professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Applied Robotics</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">5th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">5</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">30 + 30 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquaint students with basic knowledge and problem solving in the field of modern robotics.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Introduction to robotics (2 ECTS)</td><td>O1</td><td colspan="5">Classify robots with regard to type, kinematic structure and application</td></tr>
<tr><td>O2</td><td colspan="5">Analyze the basic elements of robots and manipulators</td></tr>
<tr><td>O3</td><td colspan="5">Analyze robots with regard to the parameters of robot kinematics and dynamics</td></tr>
<tr><td rowspan="4">ULO2</td><td rowspan="4">Application of robots in automated production processes (3 ECTS)</td><td>O4</td><td colspan="5">Justify the role of robots in flexible production systems and robotic cells</td></tr>
<tr><td>O5</td><td colspan="5">Create virtual simulations of robot operation in a corresponding automated production process</td></tr>
<tr><td>O6</td><td colspan="5">Create a robot program to work in a suitable automated production process</td></tr>
<tr><td>O7</td><td colspan="5">Apply programming tools for putting robots into operation</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">General about robotization. Definition of a robot. Historical development of robotics. Division, characteristics, application of robots. Introduction of robots in production. Robotized production systems. Elements and basic structures of robotic production systems. Industrial and mobile robots in modern production. Types of manipulators, robots and machines in robotic production systems. Industrial robots. Manipulators. CNC machines. Service robots. Technological robots. Assembly robots. Measuring robots. Mobile robots. Examples of production processes in which manipulators, robots and robotic systems are most often used (Outcome O1). Mechanical, energy, measurement and control systems for robots and machines. Mechanical performance of systems in robots and machines. Energy support of robots and machines. Types of measurement systems. Types of control systems. Drives in robotic systems. Electric drives. Hydraulic drives. Pneumatic drives. Presentation of the operation of robots and machines with different types of drives (Outcome O2).</td></tr>
</table>

Kinematics of robots and machines. Coordinate systems. Standards. Translations. Rotations. Basic concepts of mechanism theory, kinematic pairs, kinematic chains, degrees of freedom of motion. Connection of internal and external coordinates. Basic concepts of direct and inverse kinematics. Presentation and comparison of the kinematics of manipulators/robots and CNC processing machines with the same number of degrees of freedom of movement (Outcome O3).

The role of robots in flexible production systems and robotic cells Software tools for modeling and programming robots and their environment. Auxiliary devices, devices and machines in robotic production systems. Positioners. Vibratory feeders. Delivery routes. Delivery devices. Conveyor belts. Acceptors of manipulators and robots. Accept robot and machine tools. Systems for plasma cutting, laser cutting, water-jet cutting. Press. Equipment for robotic welding (Outcome O4).

The process of creating a virtual simulation of the robot's work in the corresponding automated production process. Sensory and robotic vision. Position sensors. Speed sensors. Force sensors. Elements of robotic vision. Image analysis. Object recognition and capture. Presentation of the operation of robots and machines in combination with different types of sensors and robotic vision (Outcome O5).

The process of creating a robot program to work in a corresponding automated production process. Programming tools for robotic production systems. Software tools for modeling robotic cells. Overview of robotic and machine languages. Planning of trajectories and motion paths of robots and similar machines. The concept of path and trajectory. The concept of G-code. Description of G and M functions when programming robots and CNC machines. Programming tools for off-line and on-line robot programming (Outcome O6).

The procedure for applying software tools for putting the robot into operation. The role of the CAD/CAM/CNC chain and the integration of modules for programming robotic systems. Movement of robots and machines from point to point - PTP. Continuous movement along the path - CP. Interpolated motion. Levels of robot and machine programming. Putting the robot into operation (Outcome O7).

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

Attendance in accordance with the Study Regulations.
Creation of all defined tasks.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project	X	Continuous knowledge assessment	X	Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Project task	Thres-hold	Max
ULO1	O1	10%		5%	**10%**
	O2	15%		7.5%	**15%**

	O3	15%		7.5%	**15%**
ULO2	O4	10%		5%	**10%**
	O5		10%	5%	**10%**
	O6		10%	5%	**10%**
	O7		30%	15%	**30%**
	Total	**50%**	**50%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
Outcomes that the student does not pass during the continuous assessment, will be passed during the examination period.
Project task refers to the creation of a practical task on equipment from the field of robotics.

Exam term:

ULO	Outcomes	Written exam	Project task	Thres-hold	Max
ULO1	O1	10%		5%	**10%**
	O2	15%		7.5%	**15%**
	O3	15%		7.5%	**15%**
ULO2	O4	10%		5%	**10%**
	O5		10%	5%	**10%**
	O6		10%	5%	**10%**
	O7		30%	15%	**30%**
	Total	**50%**	**50%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.
A passed learning outcome through continuous assessment or through the Exam term is “valid” for one calendar year, after which it is retaken.
Project task refers to the creation of a practical task on equipment from the field of robotics.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students

Pavlic, Tomislav: Lectures and exercises from the course Applied robotics, the Bjelovar University of Applied Sciences.	online	30
Supplementary reading materials:		
Šurina, Tugomir; Crneković, Mladen: Industrial robots, Školska knjiga, Zagreb, 1990. Nikolić, Gojko; Vranješ, Božo; Kunica, Zoran; Jerbić, Bojan: Designing automatic assembly systems, Kigen, Zagreb 2009. Kovačić, Zdenko; Bogdan, Stjepan; Krajči, Vesna: Basics of robotics, Grafis, Zagreb, 2000.		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

GENERAL INFORMATION							
Lead instructor	Dario Vidić, senior lecturer						
Course name	Internet of Things (IoT)						
Study program	Professional undergraduate study program in Mechatronics						
Course status	Compulsory						
Year	3rd	**Semester**	5th				
Credit value and teaching method	**Students' ECTS workload coefficient**	**5**					
	Classes total (L+E+S)*	15 + 45 + 0	L	E		S	
				AE	LE		
			15	0	45	0	

COURSE DESCRIPTION

Course objectives

The goal of this course is a detailed introduction and thorough acquisition of knowledge about the concept of the Internet of Things. The course includes the practical application of acquired knowledge in order to create a complete solution of the Internet of Things system located in the cloud, which is used for remote management, collection, processing and display of data.

Conditions for enrollment into the course

Equal to the conditions for access to obtaining the qualification.

Expected learning outcomes

Unit of learning outcomes		Learning outcomes	
ULO1	Internet of Things Concept Architecture Design Basics	**O1**	Analyze the Internet of Things Concept Architecture
		O2	Design a draft solution based on the Internet of Things
ULO2	Basics of creating the client part of the Internet of Things concept solution	**O3**	Choose a client platform for implementing a solution based on the Internet of Things
		O4	Create the client part of an IoT-based solution using a microcontroller and suitable sensors and actuators
ULO3	Basics of creating the server part of the Internet of Things concept solution	**O5**	Choose a server platform for implementing a solution based on the Internet of Things
		O6	Create the server part of a solution based on the Internet of Things using cloud computing services

Course content

1. Basics of Internet of Things concept architecture design (Outcome 1, Outcome 2)
   - 1.1. Basic concepts and architecture
   - 1.2. Areas of application
   - 1.3. Overview of trends and current events in the area
   - 1.4. Examples of used systems
   - 1.5. Creation of concept documentation of the selected system
   - 1.6. Machine learning and artificial intelligence in Internet of Things systems
   - 1.7. Application of virtual, augmented and mixed reality technologies in Internet of Things systems
2. Basics of creating the client part of the Internet of Things concept solution (Outcome 3, Outcome 4)
   - 2.1. Overview of how to create the client part of the system

2.2. Hardware for creating the client part of the system
2.3. Peripheral hardware of the client part of the system
2.4. Programming languages for creating the client part of the system
2.5. Communication protocols for exchanging information within the client part of the system
2.6. Selection and use of development environments for the development of the client part of the system
2.7. Creation of concept documentation of the prototype of the client part of the system
2.8. Creation of a prototype of the client part of the system

3. Basics of creating the server part of the internet of things concept solution (Outcome 5, Outcome 6)
3.1. Overview of how to create the server part of the system
3.2. Creation of the server part of the system in local network locations
3.3. Creation of the server part of the system in the cloud
3.4. Programming languages for creating the server part of the system
3.5. Communication protocols for information exchange within the Internet of Things system
3.6. Selection and use of development environments for the development of the server part of the system
3.7. Creation of concept documentation of the prototype of the server part of the system
3.8. Creation of a prototype of the server part of the system
3.9. Connecting the client and server parts into a complete Internet of Things system
3.10. Adaptation of the Internet of Things system to the commercial level
3.11. Presentation of the functions and purpose of the created Internet of Things system

Teaching formats	☒ lectures ☒ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

- Full-time students must attend 10 out of 12 laboratory exercises.
- Part-time students must attend 8 out of 12 laboratory exercises.
- All students are obliged to make a Project task.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam	X	Essay		Research	
Project	X	Continuous knowledge assessment	X	Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Project task	Laboratory exercises	Thres-hold	Max
ULO1	O1	8%				4%	**8%**
	O2	10%				5%	**10%**
ULO2	O3		12%			6%	**12%**
	O4			24%		12%	**24%**
ULO3	O5		12%			6%	**12%**
	O6			24%		12%	**24%**
					10%	5%	**10%**
	Total	**18%**	**24%**	**48%**	**10%**	**50%**	**100%**

During laboratory exercises, students write short tests in which it is necessary to collect a number of points that is greater than or equal to the defined threshold. Creating a project task is mandatory for every student. Project tasks are made independently or in teams of 2 to 4 students. The topic of the project task and team members are agreed upon by the students with the course director. The student has passed the course if, through the project task and Mid-term exam, she or he has achieved the number of points that is greater than or equal to the defined threshold for each learning outcome, and if he has achieved the defined threshold in the laboratory exercises. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Written exam	Project task	Oral exam	Threshold	Max
ULO 1	O1	8%			4%	**8%**
	O2	10%			5%	**10%**
ULO 2	O3	12%			6%	**12%**
	O4		24%		12%	**24%**
ULO 3	O5	12%			6%	**12%**
	O6		24%		12%	**24%**
				10%	5%	**10%**
	Total	**42%**	**48%**	**10%**	**50%**	**100%**

Creating a Project task is mandatory for every student. Project tasks are made independently or in teams of 2 to 4 students. The subject of the project task and the members of the team are agreed upon by the students with the course instructor. The student has passed the course if, through the project task, he has achieved a number of points that are greater than or equal to the defined threshold for each learning outcome, and if he has achieved the defined threshold in the oral exam. The student can take the oral exam if he has achieved the defined threshold for each learning outcome and laboratory exercises. At the oral exam, the student must achieve the defined threshold, otherwise, at the next exam period, she or he can only take the oral exam (except in the case of the 4th or 8th time taking the exam - in that case, the achieved points according to learning outcomes are reset). Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Dario vidić: Lecture presentations and materials for exercises from the "Internet of Things" course, available on the Merlin e-learning system.	online	30
Supplementary reading materials:		
Hanes, D., Salgueiro, G., Grossetete, P., Barton, R., & Henry, J. (2017). *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things.* Cisco Press. *Analytics, Artificial Intelligence, Machine Learning, Cybersecurity, Business Intelligence, Augmented Reality and Our Future.* Bravex Publications.		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Zoran Vrhovski, PhD, professional study program professor
Tomislav Pavlic, PhD, professional study program professor
Goran Benkek, lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Project</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">5th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">5</td></tr>
<tr><td rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">0 + 0 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td></td><td></td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The goal of the course is team performance of simple project tasks in the field of mechatronics.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Previously enrolled in all courses of the 1st year of study.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="5">ULO1</td><td rowspan="5">Implementation of team performance of simple project tasks from the field of mechatronics</td><td>O1</td><td colspan="5">Design a draft solution of a simple project task from the field of mechatronics through teamwork</td></tr>
<tr><td>O2</td><td colspan="5">Implement a teamwork activity plan on a simple project task in the field of mechatronics</td></tr>
<tr><td>O3</td><td colspan="5">Recognize and improve acquired knowledge and skills during team work on a simple project task in the field of mechatronics</td></tr>
<tr><td>O4</td><td colspan="5">Implement the overall solution of a simple project task in the field of mechatronics through teamwork</td></tr>
<tr><td>O5</td><td colspan="5">Present a simple project task from the field of mechatronics in written and oral form by working in a team</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Instructions for creating a Project
2. Team development of the Project (Outcomes O1, O2, O3, O4)
3. Presentation of the project carried out in the team (Outcome O5)</td></tr>
<tr><td colspan="2">Teaching formats</td><td colspan="3">☐ lectures
☒ seminars and workshops
☐ exercises
☐ distance education
☐ field course</td><td colspan="3">☐ independent work
☐ multimedia and network
☐ laboratory
☒ mentor work
☒ other: team work</td></tr>
<tr><td colspan="8">Students' obligations</td></tr>
</table>

- Project creation.
- Project presentation.

Monitoring students' work

Attendance		Activity in class		Seminar paper	X	Experimental work	X
Written exam		Oral exam		Essay		Research	
Project	X	Continuous knowledge assessment		Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Project task	Thres-hold	Max
ULO1	O1	20%	10%	**20%**
	O2	10%	5%	**10%**
	O3	10%	5%	**10%**
	O4	40%	20%	**40%**
	O5	20%	10%	**20%**
	Total	**100%**	**50%**	**100%**

At the beginning of the semester, the project course holders will define the topics of the projects. The proposer(s) of the topic are mentor(s) at project. The topic of the project and the mentor can be proposed by the students, which is approved by the course director. Students on the project work in teams of 3 or more students (maximum 8) under the leadership of the supervisor who proposed the project topic, or under the guidance of the supervisor who proposed the common topic. The student passed the course if, through the project task, she or he achieved a number of points that are greater than or equal to the defined threshold for each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

The topic of the project can be common to undergraduate professional studies in mechatronics and computer science. In that case, the student teams will be mixed. The mechatronics students in the team will work on the part of the project that concerns the mechatronic part of the project, and the computer science students in the team will work on the part of the project that concerns the computer part of the project.

Exam term:

ULO	Outcomes	Project task	Thres-hold	Max
ULO1	O1	20%	10%	**20%**
	O2	10%	5%	**10%**
	O3	10%	5%	**10%**
	O4	40%	20%	**40%**
	O5	20%	10%	**20%**
	Total	**100%**	**50%**	**100%**

Students who did not pass the Project course through continuous knowledge assessment will take it during the exam period.

The student passed the course if, through the project task, she or he achieved a number of points that are greater than or equal to the defined threshold for each learning outcome.
Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:
Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
The literature for the Project course depends on the topic covered as part of the project. The literature used in the project will be listed in the technical documentation of the project.	online	30

Supplementary reading materials:

-

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Adela Zobundžija, adjunct lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Fundamentals of Entrepreneurship</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Elective</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">5th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">30 + 15 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>30</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Apply teaching methods with the use of software tools, with which students will acquire basic knowledge about managerial and entrepreneurial competencies applicable to engineering students through acquired knowledge and skills.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="3">Unit of learning outcomes</td><td colspan="5">Learning outcomes</td></tr>
<tr><td rowspan="7">ULO1</td><td rowspan="7">Basics of entrepreneurship for students of engineering studies</td><td>O1</td><td colspan="5">Recognize and create entrepreneurial ideas with the application of an entrepreneurial approach to problem solving</td></tr>
<tr><td>O2</td><td colspan="5">Apply scientific achievements and innovation solutions in an entrepreneurial venture</td></tr>
<tr><td>O3</td><td colspan="5">Differentiate the types and procedures of establishment of legal entities</td></tr>
<tr><td>O4</td><td colspan="5">Apply entrepreneurial strategies and tactics for organizing business and delegating authority</td></tr>
<tr><td>O5</td><td colspan="5">Explain the importance of institutional support for the development of entrepreneurship and entrepreneurial support institutions at the service of entrepreneurs and start-up companies</td></tr>
<tr><td>O6</td><td colspan="5">Explain the financial aspect of an entrepreneurial venture, the tax system and cost management</td></tr>
<tr><td>O7</td><td colspan="5">Recognize and judge the possibilities of using scientific and technological achievements in the development of the company</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Concept and plans of entrepreneurship development (3P) (O1)
Assumptions and conditions for the development of entrepreneurship. Sources and definition of entrepreneurship. Change in market structure. New knowledge and guidelines for development and identification of entrepreneurial ideas. Traits and types of entrepreneurs.</td></tr>
</table>

2. **Green transition and digital transformation in entrepreneurship (**3P) (O2) – innovation solutions in application; scientific research achievements that enable the growth of productivity or the reduction of labor costs

3. **Assumptions for establishing legal entities** (6P+3V) (O3)

Entrepreneurial society, science and innovation. Establishment of a new business entity. Legal forms of micro, small and medium enterprises. Financing of an entrepreneurial idea - planning, determining the source of financial resources. Business planning. Determining the obligations of small and medium-sized entrepreneurs. Analysis of the economic justification of an entrepreneurial venture. Budgeting.

4. **Business management and development - entrepreneurial strategies and tactics** (3P + 3V) (O4)

Vision, mission, goals and strategies in entrepreneurship. Types and forms of strategies. Essential contents of individual types and forms of entrepreneurial strategies. Tactics of implementing entrepreneurial - managerial strategy. Organizational planning of entrepreneurial ventures - purpose and need. Structuring jobs and tasks. Evaluation and delegation of authority.

5. **Entrepreneurial support institutions and grants** (6P+3S) (O5)

Institutions for the development of entrepreneurship. Business incubators and technology parks. Support institutions for supporting entrepreneurs - their roles and significance. Investment and other funds. Other sources of financing.

6. **Capacities and economic sustainability of the company - small business operations** (3P+3V) (O6)

Financial factors of business - income and expenses. Material business factors. Human factors of business. Forms and types of risk in business and company development. Small business taxation. Tax forms and tax obligations of companies. Management of costs and employees. Business result and assets of the company.

7**. Entrepreneurship, science and technology in modern society** (6P + 3V) (O7)

Application of new technologies as a tool for successful implementation of entrepreneurial activity. Development and organization of science and technology parks. Integration in the development of science, technology and society. Selection of scientific and technological directions of development. Social entrepreneurship. Innovations and entrepreneurship. The focus of entrepreneurship on innovation. Effective management of resources.

Teaching formats	☒ lectures ☒ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☐ laboratory ☐ mentor work ☐ other: flipped classroom

Students' obligations

- Full-time students must attend minimum 70% of classes
- Part-time students must attend minimum 70% of classes
- Mandatory creation and submission of a seminar paper with a presentation of the results

Monitoring students' work

Attendance		Activity in class		Seminar paper	X	Experimental work	
Written exam	X	Oral exam	X	Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Seminar paper	Thres-hold	Max
ULO1	O1	10%			5%	10%
	O2	20%			10%	20%
	O3	20%			10%	20%
	O4			10%	5%	10%
	O5		20%		10%	20%
	O6		10%		5%	10%
	O7		10%		5%	10%
	Total	**50%**	**40%**	**10%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	10%	5%	10%
	O2	20%	10%	20%
	O3	20%	10%	20%
	O4	10%	5%	10%
	O5	20%	10%	20%
	O6	10%	5%	10%
	O7	10%	5%	10%
	Total	**100%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Kolaković, M. (2020) Entrepreneurship in the 21st century, Student Incubator, Zagreb	5	30

Supplementary reading materials:

- Ribić D., Pleša Puljić, N. (2020) Basics of entrepreneurship, Zagreb, Školska knjiga
- Bobera, D., Hunjet. A., Kozina, G. (2015) Entrepreneurship, Varaždin, University North

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
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Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Krešimir Markota, lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Introduction to Artificial Intelligence</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Elective</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">5th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">15 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td></td><td>15</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Learn the basic principles of artificial intelligence</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Previously enrolled in the Fundamentals of the Programming Language Python course.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="2">ULO1</td><td rowspan="2">Introduction to artificial intelligence</td><td>O1</td><td colspan="5">Describe the values that the application of artificial intelligence brings to a given area</td></tr>
<tr><td>O2</td><td colspan="5">Analyze the procedures of basic methods and algorithms in the field of artificial intelligence</td></tr>
<tr><td rowspan="2">ULO2</td><td rowspan="2">Application of artificial intelligence</td><td>O3</td><td colspan="5">For a defined problem and solution method, create a solution or improve the existing program code by applying the learned methods</td></tr>
<tr><td>O4</td><td colspan="5">Evaluate applications and background algorithms used for their implementation and critically evaluate their effectiveness and alternatives</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Basics of artificial intelligence (O1, O2)
Definition of artificial intelligence. History of the development of artificial intelligence. Applications of artificial intelligence in different fields. Introduction to machine learning. Unsupervised and supervised learning. Regression and classification methods. Data clustering. Exploratory data analysis. Display and interpretation of data.
2. Using tools when displaying data graphically (O2)
Application of various Python libraries for data set analysis such as: Pandas, Seaborn, Matplotlib, OS, OpenCv, Numpy, Scipy. Plotting different types of graphs using Seaborn and Matplotlib library. Cleaning techniques and completion of missing data. Removing noises from data. Data scaling. Standardization and normalization of data.
3. Defining different machine learning models (O3)</td></tr>
</table>

Using Tensorflow and Scikit learn library to define the model. Linear and non-linear methods. Single and multiple linear regression. Polynomial regression. Support vector machine. Dimensionality reduction methods. Neural networks. Convolutional neural networks. KNN model.
4. Spatial state searches and nature-inspired algorithms (O3)
The state space search problem. Blind search algorithms. Heuristics and directed searches. A* search. Genetic algorithms and particle swarm optimization.
5. Evaluation of model goodness (O4)
Cross validation. The confusion matrix. Accuracy, precision, Response, F1-Measure. Huber's mistake. Mean absolute error (MAE) and mean square error (MSE). Coefficient of determination (R-squared).

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☐ other: flipped classroom

Students' obligations

- **Attending lectures and laboratory exercises in accordance with the Study regulations**

Monitoring students' work

Attendance	X	Activity in class		Seminar paper		Experimental work	
Written exam		Oral exam	X	Essay		Research	
Project	X	Continuous knowledge assessment		Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Project task	Oral exam	Thres-hold	Max
ULO1	O1	20%		10%	**20%**
	O2	25%		12.5%	**25%**
ULO2	O3	25%		12.5%	**25%**
	O4	20%		10%	**20%**
			10%	5%	**10%**
	Total	**90%**	**10%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.

Exam term:

ULO	Outcomes	Project task	Oral exam	Thres-hold	Max
ULO1	O1	20%		10%	**20%**
	O2	25%		12.5%	**25%**
ULO2	O3	25%		12.5%	**25%**
	O4	20%		10%	**20%**

			10%	5%	**10%**
	Total	**90%**	**10%**	**50%**	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
● Krešimir Markota : Presentations from lectures and exercises from the course "Introduction to artificial intelligence", the Bjelovar University of Applied Sciences.	online	30

Supplementary reading materials:

- Russell, Stuart J; Norvig, Peter (2020.), Artificial Intelligence: A Modern Approach, Prentice-Hall
- Patterson D.W. Introduction to Artificial Intelligence and Expert Systems
- Haykin, S. Neural Networks – A Comprehensive Foundation, 2nd edition
- C.M. Bishop Pattern Recognition and Machine Learning

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

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<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Goran Benkek, lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Design and Production of Electronic Devices</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Elective</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">5th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">15 + 30 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>15</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquire basic knowledge about Projecting and production of electronic devices</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="6">ULO1</td><td rowspan="6">Basics of Designing and Manufacturing Electronic Devices</td><td>O1</td><td colspan="5">Select components and/or assemblies of an electronic device, taking into account the requirements of the electronic device</td></tr>
<tr><td>O2</td><td colspan="5">Create a scheme and electronic documentation of the device</td></tr>
<tr><td>O3</td><td colspan="5">Create missing components from the library</td></tr>
<tr><td>O4</td><td colspan="5">Design a printed circuit board taking into account the requirements of an electronic device</td></tr>
<tr><td>O5</td><td colspan="5">Prepare the documentation for the production and soldering of the printed circuit bord</td></tr>
<tr><td>O6</td><td colspan="5">Make a simple electronic device</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Introduction to Designing and production of electronic devices (Outcome O1)
Technologies applied in the production of elements, circuits and devices in electrical engineering, classical assembly technology (THT), surface assembly technology (SMT).
2. Electronic components (Outcome O1, O2)
Electronic components for classic and surface mounting, housings and component designs, IC housings for classic and surface mounting, packaging of components.
3. Creation of the scheme and electronic documentation of the device (Outcome 2)
Creation of electronic schemes in the CAD tool, documentation of the scheme, separation of the scheme into functional blocks.
4. Creation of the missing component (Outcome 3)
Create a symbol and footprint of a component that is not in the CAD tool library or database.
5. Printed circuit board design (Outcome O4)</td></tr>
</table>

Printed circuit board design, technological steps of printed circuit board production, guidelines for quality design, design for production and robust design. Printed circuit boards of mixed technology (THT and SMT), aspects important for SMT design. Use of libraries, addition of components, interconnection of components

Placement of components on the printed circuit board, placement of copper surfaces (prohibition areas, connection of signal lines, grounding and polygons).

6. **Installation and soldering of electronic components** (Outcome O4)

THT technology, solder wave, surface mounting, solder paste, soldering technologies, soldering errors, testing of finished boards with components.

7. **Preparation of documentation for production** (Outcome O5)

Generation of graphic files, use of CAM models, generation of output files for the production of printed circuit boards, creation of blueprints of the printed circuit board based on the design, generation of component lists.

8. **Technology of printed connections** (Outcome O6)

Substrates, single-sided printed circuit boards, double-sided printed circuit boards with metallization, special printed circuit boards, protective coatings.

9. **Basic processes of printed circuit board production** (Outcome O6)

Photolithography, screen printing, etching, metallization, procedures for achieving mechanical and electrical connections.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☐ other: flipped classroom

Students' obligations

- Full-time students must attend 7 out of 10 laboratory exercises.
- Part-time students must attend 5 out of 10 laboratory exercises.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam		Oral exam	X	Essay		Research	
Project	X	Continuous knowledge assessment		Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Oral exam	Laboratory exercises	Project	Thres-hold	Max
ULO1	O1			16%	8%	**16%**
	O2			16%	8%	**16%**
	O3			16%	8%	**16%**
	O4			16%	16%	**16%**
	O5			16%	8%	**16%**
	O6		10%		5%	**10%**

		10%			5%	**10%**
	Total	**10%**	**10%**	**80%**	**50%**	**100%**

Creating a project task is mandatory for every student. Project tasks are created independently. The subject of the project task is agreed upon by the student with the course director. The student has passed the course if, through the project task, she or he has achieved a number of points that are greater than or equal to the defined threshold for each learning outcome, and if he has achieved the defined threshold in the oral exam. The student can take the oral exam if she or he has achieved the defined thresholds for each learning outcome and laboratory exercises. At the oral exam, the student must achieve the defined threshold, otherwise, at the next exam period, she or he can only take the oral exam (except in the case of the 4th or 8th time taking the exam - in that case, the achieved points according to Learning Outcomes are reset). Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Oral exam	Laboratory exercises	Project	Thres-hold	Max
ULO1	O1			16%	8%	**16%**
	O2			16%	8%	**16%**
	O3			16%	8%	**16%**
	O4			16%	16%	**16%**
	O5			16%	8%	**16%**
	O6		10%		5%	**10%**
		10%			5%	**10%**
	Total	**10%**	**10%**	**80%**	**50%**	**100%**

Creating a project task is mandatory for every student. Project tasks are created independently. The subject of the project task is agreed upon by the student with the course director. The student has passed the course if, through the project task, she or he has achieved a number of points that are greater than or equal to the defined threshold for each learning outcome, and if he has achieved the defined threshold in the oral exam. The student can take the oral exam if she or he has achieved the defined thresholds for each learning outcome and laboratory exercises (Outcome O6). If a student does not achieve a number of points that are greater than or equal to the defined threshold in the laboratory exercises during the continuous assessment, she or he is obliged to repeat the laboratory exercise at the time agreed with the course director. At the oral exam, the student must achieve the defined threshold, otherwise, at the next exam period, she or he can only take the oral exam (except in the case of the 4th or 8th time taking the exam - in that case, the achieved points according to Learning Outcomes are reset). Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)

50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Benkek, Goran: "Presentation of lectures and scripts for laboratory exercises - Design and production of electronic devices ", the Bjelovar University of Applied Sciences	online	30

Supplementary reading materials:

Duncan, Mitchell: Eagle V6: Getting Started Guide [PCB Design], 2013
Coombs, Clyde: Printed Circuits Handbook, 2007
Williams, Tim: The Circuit Designer's Companion, 2013
Bogatin, Eric: Signal and Power Integrity, 2009

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Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Stjepan Golubić, PhD, adjunct professional study program professor</td></tr>
<tr><td>Course name</td><td colspan="7">Technical Materials and Production Processes</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">6th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">6</td></tr>
<tr><td rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">45 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td></td><td></td><td>45</td><td>30</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">Acquaint students with the types and structure of materials, state diagrams, basic properties of materials, heat treatment procedures, testing of metal materials, labeling and application of basic types of technical materials.
Acquaint students with the basics of production technologies, with an emphasis on the needs of mechatronics.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="5">ULO1</td><td rowspan="5">Basic properties of technical materials</td><td>O1</td><td colspan="5">Differentiate groups of technical materials with regard to the composition, structure and properties of technical materials</td></tr>
<tr><td>O2</td><td colspan="5">Analyze the basic properties of metallic materials</td></tr>
<tr><td>O3</td><td colspan="5">Analyze the basic properties of non-metallic materials</td></tr>
<tr><td>O4</td><td colspan="5">Analyze the procedures for testing the basic mechanical properties of materials and technological testing of materials</td></tr>
<tr><td>O5</td><td colspan="5">Choose adequate technical material for the given purpose</td></tr>
<tr><td rowspan="5">ULO2</td><td rowspan="5">Basic production processes for processing technical materials</td><td>O6</td><td colspan="5">Analyze basic production processes for processing technical materials</td></tr>
<tr><td>O7</td><td colspan="5">Choose an appropriate production process or a combination of production processes when processing technical materials</td></tr>
<tr><td>O8</td><td colspan="5">Choose appropriate tools when processing technical materials</td></tr>
<tr><td>O9</td><td colspan="5">Analyze the advantages and disadvantages of individual production procedures when processing technical materials</td></tr>
<tr><td>O10</td><td colspan="5">Classify the production processes of metal and polymer components according to different criteria</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Types of materials according to chemical composition (Outcome O1).
2. Structure and properties of technical materials (Outcome O1).</td></tr>
</table>

3. Metallic materials, crystallography and basics of metallography, state diagrams. Ferrous and non-ferrous materials and alloys, sintered materials. Heat treatment of steel. (Outcome O2).
4. Non-metallic materials, polymer materials, ceramic materials, composite materials, foams, other materials (Outcome O3).
5. Testing of mechanical and technological properties: Testing of static and dynamic durability, testing of technological properties of materials, hardness testing, static tensile and compressive testing (Outcome O4).
6. Method of choosing materials for the selected product, examples of material application. Marking of materials based on iron and non-ferrous metals according to HRH and EN standards (Outcome O5).
7. Introduction to production technologies (Outcome O6).
8. Production processes (Outcome O6).
9. Technological and production processes, procedures for processing technical materials (Outcome O7).
10. Selection of tools for processing technical materials (Outcome O8).
11. Analysis of procedures for processing technical materials and presentation of advantages and disadvantages of individual procedures (Outcome O9).
12. Production procedures of metal and polymer components (Outcome O10).

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☐ independent work ☐ multimedia and network ☐ laboratory ☐ mentor work ☐ other: flipped classroom

Students' obligations

- Attending lectures and auditory exercises according to the Study Regulations.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project		Continuous knowledge assessment	X	Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam 1	Mid-term exam 2	Thres-hold	Max
ULO1	O1	10%		5%	**10%**
	O2	10%		5%	**10%**
	O3	10%		5%	**10%**
	O4	10%		5%	**10%**
	O5	10%		5%	**10%**
ULO2	O6		10%	5%	**10%**
	O7		10%	5%	**10%**
	O8		10%	5%	**10%**
	O9		10%	5%	**10%**
	O10		10%	5%	**10%**
	Total	**50%**	**50%**	50%	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.

Exam term:

ULO	Outcomes	Written exam	Thres-hold	Max
ULO1	O1	10%	5%	**10%**
	O2	10%	5%	**10%**
	O3	10%	5%	**10%**
	O4	10%	5%	**10%**
	O5	10%	5%	**10%**
ULO2	O6	10%	5%	**10%**
	O7	10%	5%	**10%**
	O8	10%	5%	**10%**
	O9	10%	5%	**10%**
	O10	10%	5%	**10%**
	Total	**100%**	50%	**100%**

The student has passed the course if for each learning outcome she or he has achieved a percentage of points that is greater than and equal to the defined threshold.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
1. Engineering Handbook IP4, Volume One - Materials, Školska knjiga Zagreb, 1998.	10	30
2. Golubić, Stjepan: Lecture presentations from the Technical Materials course, the Bjelovar University of Applied Sciences, http://vub.hr/tehnicki-materijali-program/tehnicki-materijali/	online	30
3. Golubić, Stjepan: Technical materials, part I, metal materials, the Bjelovar University of Applied Sciences, Bjelovar, 2019.	10	30

4. Šavar Šime: Processing by particle separation, University Press Liber, Zagreb, 1991.	9	30
5. Bošnjaković, Mladen; Stoić, Antun: Programming of CNC machines, University in Slavonski Brod, Slavonski Brod, 2011.	4	30
Supplementary reading materials:		
1. Filetin, Tomislav; Kovačiček, Franjo; Indof, Janez: Properties and application of materials, the Faculty of Mechanical Engineering and Naval Architecture, Zagreb, 2007. 2. Filetin, Tomislav: Selection of materials for product development, the Faculty of Mechanical Engineering and Naval Architecture, Zagreb, 2006. 3. Ivušić, Vinko: State diagram of metals and alloys, the Faculty of Mechanical Engineering and Naval Architecture, Zagreb, 2003. 4. Vitez, Ivan: Examination of the mechanical properties of metallic materials, Faculty of Engineering, Slavonski Brod, 2006.		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Goran Benkek, lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Professional practice</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">6th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">6</td></tr>
<tr><td rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">0 + 0 + 10</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td></td><td>0</td><td>0</td><td>0</td><td>10</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The objective of the course is to gain practical experience by working in an organization.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Enrolling in all 1st-year courses.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Personal and professional development through work in an organization</td><td>O1</td><td colspan="5">Apply the knowledge and skills acquired during the course of study to a specific work assignment in an organization</td></tr>
<tr><td>O2</td><td colspan="5">Participate in the work of the team in solving assigned work-related tasks in the organization</td></tr>
<tr><td>O3</td><td colspan="5">Act in accordance with the rules of conduct in the organization, the rules of safety and protection at work, as well as the instructions and recommendations of the mentor and other authorized persons in the organization</td></tr>
<tr><td rowspan="2">ULO2</td><td rowspan="2">Documenting practical experience gained in an organization</td><td>O4</td><td colspan="5">Write an apprenticeship journal based on practical experience gained in the organization</td></tr>
<tr><td>O5</td><td colspan="5">Present the practical experience gained in the organization</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Instructions for carrying out the apprenticeship
2. Work in the organization (Outcomes O1, O2, O3)
3. Writing an apprenticeship journal (Outcomes O4, O5)</td></tr>
<tr><td>Teaching formats</td><td colspan="3">☐ lectures
☐ seminars and workshops
☐ exercises
☐ distance education
☐ field course</td><td colspan="4">☒ independent work
☐ multimedia and network
☐ laboratory
☒ mentor work
☐ other:</td></tr>
<tr><td colspan="8">Students' obligations</td></tr>
</table>

- 170 hours of apprenticeship completed.
- Writing an apprenticeship journal.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam		Oral exam		Essay		Research	
Project		Continuous knowledge assessment		Report		Practical work	X
Portfolio		Professional practice journal	X				

Grading and evaluating students' work in-class and at the final exam

This course is not graded, but it is recorded whether the student has passed or failed the apprenticeship. The apprenticeship mentor (from the organization) and the apprenticeship director evaluate the apprenticeship journal according to the learning outcomes of the course. The student has passed the course if the apprenticeship journal has been accepted.

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Instructions for conducting the apprenticeship://vub.hr/strucna-praksa-mehatronika/	online	30

Supplementary reading materials:

-

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Lead instructor at the Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course name</td><td colspan="7">Final thesis</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Compulsory</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td colspan="2">Semester</td><td colspan="2">6th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="6">10</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">0 + 0 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The objective of the course is independent research, solution and written and oral presentation of a given problem from the field of technical sciences, area of mechatronics.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Enrolling in all 1st-year and 2nd-year courses.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Independent use of literature in technical sciences</td><td>O1</td><td colspan="5">Use literature to find relevant professional and academic information by using library services, databases and services on the Internet</td></tr>
<tr><td>O2</td><td colspan="5">Demonstrate an understanding of plagiarism, self-plagiarism, citations, references, and paraphrasing</td></tr>
<tr><td>O3</td><td colspan="5">Demonstrate the ability to independently use professional and scientific literature to solve a simpler problem in the technical sciences</td></tr>
<tr><td rowspan="4">ULO2</td><td rowspan="4">Independent solution of a simple problem in technical sciences</td><td>O4</td><td colspan="5">Analyze a given unstructured problem in technical sciences and model its solution conceptually</td></tr>
<tr><td>O5</td><td colspan="5">Acquire the knowledge and skills necessary to successfully solve a given simpler problem in technical sciences</td></tr>
<tr><td>O6</td><td colspan="5">Identify and apply appropriate research or specialized methods, techniques, and tools to solve a given problem or question relevant to the field of technical sciences</td></tr>
<tr><td>O7</td><td colspan="5">Integrate knowledge and skills from various fields to independently complete the final project based on the analysis conducted, taking into account the requirements and standards of the profession and using modern technologies, tools and methods</td></tr>
<tr><td rowspan="2">ULO3</td><td rowspan="2">Written and oral presentation of the solution to the problem</td><td>O8</td><td colspan="5">Apply the guidelines for the written formatting of an academic paper</td></tr>
<tr><td>O9</td><td colspan="5">Provide arguments for an opinion in written form</td></tr>
</table>

		O10	Create a presentation plan taking into account the time available and the target audience
		O11	Present the paper in written and oral form in a linguistically and ethically correct manner in accordance with the given guidelines

Course content

The content of the final thesis depends on the selected topic.

Teaching formats	☐ lectures ☐ seminars and workshops ☐ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☐ laboratory ☒ mentor work ☒ other: Research

Students' obligations

- Writing the final thesis in accordance with the guidelines prescribed in the Regulation on the Final thesis.
- Presentation of the final thesis in accordance with the guidelines prescribed in the Regulation on the Final thesis.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	X
Written exam		Oral exam		Essay		Research	X
Project		Continuous knowledge assessment		Report		Practical work	X
Portfolio		Writing the final thesis	x	Presenting the final thesis	X		

Grading and evaluating students' work in-class and at the final exam

Grading and evaluation of the student's final thesis is prescribed by the Regulations on the Final thesis.

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
The literature for the course "Final thesis" depends on the topic covered in the final thesis. The literature used in the final thesis will be listed in the printed version of the final thesis.	-	-

Supplementary reading materials:

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td colspan="2">Lead instructor</td><td colspan="6">Zoran Vrhovski, PhD</td></tr>
<tr><td colspan="2">Course name</td><td colspan="6">Automation of Machines and Devices</td></tr>
<tr><td colspan="2">Study program</td><td colspan="6">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td colspan="2">Course status</td><td colspan="6">Elective</td></tr>
<tr><td colspan="2">Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">6th</td></tr>
<tr><td colspan="2" rowspan="3">Credit value and teaching method</td><td colspan="2">Students’ ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td colspan="2" rowspan="2">15 + 30 + 0</td><td>L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td colspan="2"></td><td colspan="2"></td><td>15</td><td></td><td>30</td><td></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The objective of the course is to acquaint students with the fundamentals of designing photovoltaic systems</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="3">ULO1</td><td rowspan="3">Basics of the use of HMI devices</td><td>O1</td><td colspan="5">Configure the HMI device to automate simple production processes</td></tr>
<tr><td>O2</td><td colspan="5">Create a programmable logic controller driver for data exchange with the HMI device</td></tr>
<tr><td>O3</td><td colspan="5">Create a user interface of the HMI device for user interaction with a simple production process</td></tr>
<tr><td rowspan="3">ULO2</td><td rowspan="3">Basics of using the device to control the position and rotation speed of the servo motor</td><td>O4</td><td colspan="5">Configure the servo driver to control the position and speed of the servo motor</td></tr>
<tr><td>O5</td><td colspan="5">Configure the programmable logic controller to work with the servo driver</td></tr>
<tr><td>O6</td><td colspan="5">Create a driver program for a programmable logic controller to control the position and speed of the servo motor using a servo driver</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. HMI
HMI devices: application and functions. Creating an HMI project in a development environment. Configuring the HMI device. Establishing communication with the PLC device. (Outcome O1)
Creating the PLC control program for data exchange with the HMI device. Preparation of data for exchange between PLC and HMI. (Outcome O2)
Creation of the HMI user interface in the development environment: local variables, import of variables from PLC devices, graphic design, animations and controls, pop-up windows, trends, alarms and events, recipes, other functions. (Outcome O3)</td></tr>
</table>

2. Automation of machines and devices using servomotors

Servo motor: application and functions. Servo driver: application and functions. Configuring the servo driver. (Outcome O4)

Configuring the PLC device to work with the servo driver. (Outcome O5)

Controlling the position and rotation speed of the servo motor. Control program of the PLC device to control the position and rotation speed of the servo motor. (Outcome O6)

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☐ other:

Students' obligations

- Attending classes according to the Study Regulations.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project	X	Continuous knowledge assessment		Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Project task	Thres-hold	Max
ULO1	O1	10%	5%	**10%**
	O2	14%	7%	**14%**
	O3	26%	13%	**26%**
ULO2	O4	16%	8%	**16%**
	O5	16%	8%	**16%**
	O6	18%	9%	**18%**
	Total	**100%**	**50%**	**100%**

The preparation of a project task is mandatory for every student. Project tasks are created independently or in teams of 2 to 4 students. The topic of the project task and the team members are determined by the students in consultation with the course director. The student has passed the course if he/she achieved a number of points through the project task that is greater than or equal to the specified threshold for each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Project task	Thres-hold	Max
ULO1	O1	10%	5%	**10%**

	O2	14%	7%	**14%**
	O3	26%	13%	**26%**
ULO2	O4	16%	8%	**16%**
	O5	16%	8%	**16%**
	O6	18%	9%	**18%**
	Total	**100%**	**50%**	**100%**

The preparation of a project task is mandatory for every student. Project tasks are created independently or in teams of 2 to 4 students. The topic of the project task and the team members are determined by the students in consultation with the course director. The student has passed the course if he/she achieved a number of points through the project task that is greater than or equal to the specified threshold for each learning outcome. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Zoran Vrhovski, Teaching materials for the course Automation of machines and devices, on the Merlin e-learning platform	online	30

Supplementary reading materials:

- Schneider Electric, Vijeo Designer Training Manual, 2015.

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Elizabeth Hedl</td></tr>
<tr><td>Course name</td><td colspan="7">Designing Photovoltaic Systems</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Elective</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">6th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">15 + 30 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td colspan="2"></td><td>15</td><td>15</td><td>15</td><td></td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The objective of the course is to introduce students to designing photovoltaic systems</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Equal to the conditions for access to obtaining the qualification.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="3">Unit of learning outcomes</td><td colspan="5">Learning outcomes</td></tr>
<tr><td rowspan="7">ULO1</td><td rowspan="7">Fundamentals of Designing Photovoltaic Systems</td><td>O1</td><td colspan="5">Explain the functional principle of the components of photovoltaic systems</td></tr>
<tr><td>O2</td><td colspan="5">Distinguish between different types of photovoltaic modules and explain the structure of photovoltaic modules</td></tr>
<tr><td>O3</td><td colspan="5">Analyze the effects of shading on the photovoltaic system</td></tr>
<tr><td>O4</td><td colspan="5">Analyze the potential of solar energy for a specific area</td></tr>
<tr><td>O5</td><td colspan="5">Distinguish between off-grid, grid-connected and hybrid photovoltaic systems in terms of components</td></tr>
<tr><td>O6</td><td colspan="5">Design a simple photovoltaic system according to the requirements</td></tr>
<tr><td>O7</td><td colspan="5">Analyze the conformity of the components of a photovoltaic system and the profitability</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Ecological characteristics of solar energy. Solar energy in Croatia. Photovoltaic cell and principle of operation. Components of photovoltaic systems. Photovoltaic modules. Batteries (lead and lithium-ion). The process of discharging and charging the battery. Battery charge controller. Heat exchanger. Bidirectional converter. Autonomous inverter. Network exchanger. (Outcome O1)
2. Materials in solar energy (silicon, semiconductor combinations, perovskite, graphene). Types of photovoltaic modules. Structure of solar cells and modules. Characteristic electrical parameters of the photovoltaic module. The influence of temperature on the current-voltage characteristic of the photovoltaic module. Characteristic mechanical parameters of the photovoltaic module. Problems of degradation and efficiency of photovoltaic modules. (Outcome O2).</td></tr>
</table>

3. Shading of the photovoltaic cell. Current-voltage characteristics of the photovoltaic module in relation to shading. Bypass diodes in photovoltaic modules. The influence of shading on the photovoltaic module at a specific location in relation to surrounding objects. Analysis of the generated voltage and maximum power in relation to the increase in shading. (Outcome O3)
4. Solar energy potential for a given area. Public service for calculating the energy production of photovoltaic panels. Learning how to work with the PVGIS system. Analysis of data obtained with the PVGIS system. (Outcome O4)
5. Types of photovoltaic systems. Off-grid photovoltaic systems. Grid-connected photovoltaic systems (Outcome O5)
6. Project an island photovoltaic system at a specific location. Definition of the object consumption. Selection of the basic system parameters. Calculation of battery capacity and daily charging. Calculating the number of modules required. (Outcome O6)
7. Checking the compatibility of the components. Adjusting the voltage of the photovoltaic modules and the input of the inverter. Adjust the bidirectional inverter according to the voltage of the battery bank. Check the possibility of transmitting the power of the photovoltaic array to the batteries via the charger. Checking the maximum continuous power of the load. Economic characteristics of solar energy. Cost-effectiveness analysis. (Outcome O7)

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☐ other:

Students' obligations

- Attending classes according to the Study Regulations.

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam	X	Oral exam		Essay		Research	
Project	X	Continuous knowledge assessment		Report		Practical work	X
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Mid-term exam	Project task	Thres-hold	Max
ULO1	O1	15%		7.5%	15%
	O2	15%		7.5%	15%
	O3		10%	5%	10%
	O4		10%	5%	10%
	O5	10%		5%	10%
	O6		25%	12.5%	25%
	O7		15%	7.5%	15%
	Total	**40%**	**60%**	**50%**	**100%**

The student has passed the course if he/she has achieved a percentage of points for each learning outcome that is greater than or equal to the specified threshold and if he/she has achieved a percentage of points for the project task that is greater than or equal to the specified threshold. Completion of the project task is mandatory and the project tasks may relate to any learning outcome or combination of learning outcomes of the course. The student will begin working on the project task when he/she has achieved a percentage of points that is greater than or equal to the defined threshold for each learning outcome. Depending on the quality of the project task, the student receives points. The student has passed the course if they have achieved a percentage of points for each learning outcome that is greater than or equal to the defined threshold and if they have achieved a number of points for the project task that is greater than or equal to the defined threshold for the project task. If the student does not achieve the number of points for the project task defined by the threshold value, the student is considered to not have passed the exam and will only take the project task at the examination period. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Exam	Project task	Thres-hold	Max
ULO1	O1	15%		7.5%	15%
	O2	15%		7.5%	15%
	O3		10%	5%	10%
	O4		10%	5%	10%
	O5	10%		5%	10%
	O6		25%	12.5%	25%
	O7		15%	7.5%	15%
	Total	**40%**	**60%**	**50%**	**100%**

The student has passed the course if he/she has achieved a percentage of points for each learning outcome that is greater than or equal to the specified threshold and if he/she has achieved a percentage of points for the project task that is greater than or equal to the specified threshold. Completion of the project task is mandatory and the project tasks may relate to any learning outcome or combination of learning outcomes of the course. The student will begin working on the project task when he/she has achieved a percentage of points that is greater than or equal to the defined threshold for each learning outcome. Depending on the quality of the project task, the student receives points. The student has passed the course if they have achieved a percentage of points for each learning outcome that is greater than or equal to the defined threshold and if they have achieved a number of points for the project task that is greater than or equal to the defined threshold for the project task. Points earned on the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

Based on the sum of the total points achieved in the course, the grade is defined according to the following table:

Points range	Exam grade
0.00 – 49.99	insufficient (1)
50.00 – 59.99	sufficient (2)
60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course		
Title	Number of copies	Number of students
Island photovoltaic systems – Practical Handbook	10	30
Hedl, Elizabeth: Presentations and instructions from the lectures (Merlin)	online	30
Supplementary reading materials:		
Majdandžić, Ljubomir: Solar Sysytems, Graphis d.o.o., Zagreb, 2010. Labudović, Boris: Renewable Energy Sources, Energetika marketing, Zagreb, 2002		
Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences		
Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys. Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators. Regular updating and modernization of courses.		

<table>
<tr><td colspan="8">GENERAL INFORMATION</td></tr>
<tr><td>Lead instructor</td><td colspan="7">Ante Javor, adjunct lecturer</td></tr>
<tr><td>Course name</td><td colspan="7">Computer Vision</td></tr>
<tr><td>Study program</td><td colspan="7">Professional undergraduate study program in Mechatronics</td></tr>
<tr><td>Course status</td><td colspan="7">Elective</td></tr>
<tr><td>Year</td><td colspan="2">3rd</td><td>Semester</td><td colspan="3">6th</td></tr>
<tr><td rowspan="3">Credit value and teaching method</td><td colspan="2">Students' ECTS workload coefficient</td><td colspan="5">4</td></tr>
<tr><td colspan="2" rowspan="2">Classes total (L+E+S)*</td><td rowspan="2">20 + 25 + 0</td><td rowspan="2">L</td><td colspan="2">E</td><td rowspan="2">S</td></tr>
<tr><td>AE</td><td>LE</td></tr>
<tr><td></td><td colspan="2"></td><td>20</td><td>0</td><td>25</td><td>0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td colspan="8">Course objectives</td></tr>
<tr><td colspan="8">The objective of the course is to create a software solution for interpreting and analyzing data from digital images using computer vision algorithms.</td></tr>
<tr><td colspan="8">Conditions for enrollment into the course</td></tr>
<tr><td colspan="8">Enrollment in the course Fundamentals of the Programming Language Python.</td></tr>
<tr><td colspan="8">Expected learning outcomes</td></tr>
<tr><td colspan="2">Unit of learning outcomes</td><td colspan="6">Learning outcomes</td></tr>
<tr><td rowspan="5">ULO1</td><td rowspan="5">Basics of image processing and computer vision</td><td>O1</td><td colspan="5">Distinguish between digital image management methods, formats, and camera models</td></tr>
<tr><td>O2</td><td colspan="5">Apply basic algorithms and operations for digital image processing</td></tr>
<tr><td>O3</td><td colspan="5">Apply basic algorithms for image analysis from the field of computer vision</td></tr>
<tr><td>O4</td><td colspan="5">Analyze software solutions based on image processing and computer vision algorithms</td></tr>
<tr><td>O5</td><td colspan="5">Implement a software solution based on image processing and computer vision algorithms</td></tr>
<tr><td colspan="8">Course content</td></tr>
<tr><td colspan="8">1. Introduction (Outcome O1)
Physics of vision. Introduction to computer vision. Overview of software support for image analysis (Tensorflow, PyTorch, OpenCV). Display of the image on the computer.
2. Camera and acquisition (Outcome O1, O2)
Overview of hardware support for image acquisition. Camera types. Communication protocols for image transfer. Lighting. Image parameters during acquisition. Mathematical model of the camera. Calibration of the camera.
3. Image processing (Outcome O2)
Region of interest. Basic operators in the image. Image rotation. Mirroring of the image. Image distortion. Image filtering. Image smoothing. Image features.
4. Image analysis (Outcome O3, O4)
Morphological image processing. Extraction of edges. Detection of shapes. Histograms. Face recognition.</td></tr>
</table>

5. **OpenCV (Outcome O2, O3, O5)**
   An overview of the OpenCV library for image preprocessing and analysis. Image acquisition. Image processing and analysis. Examples from practice.
6. **Advanced applications and use (Outcome O4, O5)**
   Robotic vision. Acquiring a depth image from a single camera. Acquiring a depth image from two cameras (stereo vision). OCR. Object recognition. Classification of images.

Teaching formats	☒ lectures ☐ seminars and workshops ☒ exercises ☐ distance education ☐ field course	☒ independent work ☐ multimedia and network ☒ laboratory ☐ mentor work ☒ other: flipped classroom

Students' obligations

- Attendance at 70% of the laboratory exercises for full-time students
- Attendance at 50% of the laboratory exercises for part-time students
- Preparing a project task

Monitoring students' work

Attendance		Activity in class		Seminar paper		Experimental work	
Written exam		Oral exam	X	Essay		Research	
Project	X	Continuous knowledge assessment		Report		Practical work	
Portfolio							

Grading and evaluating students' work in-class and at the final exam

Continuous knowledge assessment:

ULO	Outcomes	Project task	Oral exam	Thres-hold	Max
ULO1	O1	16%		8%	**16%**
	O2	16%		8%	**16%**
	O3	16%		8%	**16%**
	O4	16%		8%	**16%**
	O5	16%		8%	**16%**
			20%	10%	**20%**
	Total	**80%**	**20%**	**50%**	**100%**

The student takes the oral examination if he or she has reached the specified thresholds for each learning outcome. At the oral exam, the student must reach the specified threshold; if not, he/she only takes the oral exam in the next exam term (except in the case of taking the exam the 4th or 8th time – in this case, the points achieved in the learning outcomes are reset). The points achieved for the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Exam term:

ULO	Outcomes	Project task	Oral exam	Threshold	Max
ULO1	O1	16%		8%	**16%**

	O2	16%		8%	**16%**
	O3	16%		8%	**16%**
	O4	16%		8%	**16%**
	O5	16%		8%	**16%**
			20%	10%	**20%**
	Total	**80%**	**20%**	**50%**	**100%**

The student takes the oral examination if he or she has reached the specified thresholds for each learning outcome. At the oral exam, the student must reach the specified threshold; if not, he/she only takes the oral exam in the next exam term (except in the case of taking the exam the 4th or 8th time – in this case, the points achieved in the learning outcomes are reset). The points achieved for the passed learning outcomes are deleted one year after the beginning of the semester in which the course is taught.

Course grading:

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60.00 – 74.99	good (3)
75.00 – 89.99	very good (4)
90.00 – 100.00	excellent (5)

Compulsory reading and the number of copies in proportion to the number of students currently attending the course

Title	Number of copies	Number of students
Ante Javor: Presentations from the lectures and exercises from the course Computer Vision, available at the e-learning platform Merlin	online	30

Supplementary reading materials:

- Rafael C. Gonazales, Richard E. Woods, Digital image processing, Person, 2017 4th Edition.
- Richard Szelinski, Computer Vision: Algorithms and Application, Springer, 2021

Methods of quality monitoring that ensure the acquisition of output knowledge, skills, and competences

Conducting student surveys and analyzing data in accordance with the results of the Commission for Conducting Student Surveys.
Analysis of quality indicators that analyzes students' studying, passing exams, employment rate of graduated students and other quality indicators.
Regular updating and modernization of courses.

Competences acquired on completion of the study module and study programme

Program learning outcome code:	LEARNING OUTCOMES OF THE PROFESSIONAL UNDERGRADUATE STUDY PROGRAM IN MECHATRONICS
IU1	Apply modern techniques, skills, and programming tools for modeling, designing, analyzing, and verifying mechatronic systems.
IU2	Design mechatronic systems based on the given technical specification, paying attention to the rules of the profession and quality assurance.
IU3	Select sensors, actuators, computer controllers, machine elements, and other elements for the creation of a mechatronics system.
IU4	Implement the automation of the production process based on the given technical specifications.
IU5	Implement appropriate control algorithms in mechatronic systems.
IU6	Create technical documentation of the mechatronics system and its subsystems.
IU7	Analyze and interpret data based on conducted tests and experiments with the aim of developing, testing, and maintaining mechatronic systems.
IU8	Propose innovative solutions in the field of mechatronics by analyzing and evaluating current knowledge, models, and solutions.
IU9	Apply different strategies for project planning and development.
IU10	Identify, formulate, and solve engineering problems by applying principles from the fields of engineering, technical sciences, and mathematics.
IU11	Apply the principles of effective communication in the local and international environment.
IU12	Manage your own professional and personal development through active learning and continuous improvement.
IU13	Plan and organize independent work and work in multidisciplinary teams.