UNIVERSITY OF SPLIT

FACULTY OF ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE

DETAILED PROPOSAL OF THE STUDY PROGRAMME

UNDERGRADUATE UNIVERSITY STUDY IN MECHANICAL ENGINEERING

SPLIT, February 2022

1.1. List of mandatory and elective courses

List of courses								
Year of study: 1.								
Semester: I.								
STATUS	CODE	COURSE	HOURS IN SEMESTER					ECTS
			L	S	AE	LE	DE	
Mandatory	FEMX01	Mathematics 1	45	0	45	0	0	7
	FETC01	Materials 1	45	0	0	30	0	6
	FEMC03	Physics	45	0	0	0	0	4
	L = Lectures, S = Seminar, AE = Auditory Exercises, LE = Laboratory Exercises, DE = Design Exercises							

List of courses								
Year of study: 1.								
Semester: II.								
STATUS	CODE	COURSE	HOURS IN SEMESTER					ECTS
			L	S	AE	LE	DE	
Mandatory	FEMX02	Mathematics 2	45	0	45	0	0	7
	FESC05	Material Mechanics 1	45	0	30	0	0	6
	L = Lectures, S = Seminar, AE = Auditory Exercises, LE = Laboratory Exercises, DE = Design Exercises							

List of courses								
Year of study: 2.								
Semester: III.								
STATUS	CODE	COURSE	HOURS IN SEMESTER					ECTS
			L	S	AE	LE	DE	
	FESC06	Thermodynamics 1	45	0	30	0	0	7
	FESC22	Computer- Aided Analysis	30	0	0	30	0	5
	FESC08	Mechanics of Materials 2	30	0	30	0	0	5
	L = Lectures, S = Seminar, AE = Auditory Exercises, LE = Laboratory Exercises, DE = Design Exercises							

List of courses								
Year of study: 2.								
Semester: IV.								
STATUS	CODE	COURSE	HOURS IN SEMESTER					ECTS
			L	S	AE	LE	DE	
	FESC09	Thermodynamics 2	45	0	30	0	0	7
	FETC03	Technology 1	60	0	0	30	0	6
	L = Lectures, S = Seminar, AE = Auditory Exercises, LE = Laboratory Exercises, DE = Design Exercises							

List of courses								
Year of study: 3.								
Semester: V.								
STATUS	CODE	COURSE	HOURS IN SEMESTER					ECTS
			L	S	AE	LE	DE	
	FETC04	Technology 2	60	0	0	30	0	6
	FESC14	Thermal Machines	45	0	15	15	0	6
	FENC01	Electrical Engineering and Electronics	30	0	15	15	0	4
	L = Lectures, S = Seminar, AE = Auditory Exercises, LE = Laboratory Exercises, DE = Design Exercises							

List of courses								
Year of study: 3.								
Semester: VI.								
STATUS	CODE	COURSE	HOURS IN SEMESTER					ECTS
			L	S	AE	LE	DE	
	FETC13	Theory and Technique Of Measurement	45	0	0	15	0	5
	FESC18	Design of Industrial Products	30	0	0	0	30	4
	FESC26	Noise and Vibration Control	30	0	15	15	0	4
	FESC27	Race Vehicle Project	15	15	0	0	30	4
	L = Lectures, S = Seminar, AE = Auditory Exercises, LE = Laboratory Exercises, DE = Design Exercises							

1.2. Course description

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="6">MATHEMATICS 1</td></tr>
<tr><td>Code</td><td>FEMX01</td><td>Year of study</td><td colspan="5">1</td></tr>
<tr><td>Course teacher</td><td>Ivan Slapničar, Ph.D., Full Professor,
Anita Matković, Ph.D., Associate Professor,
Josipa Barić, Ph.D., Assistant Professor.</td><td>Credits (ECTS)</td><td colspan="5">7</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Ph.D. Nevena Jakovčević Stor, Irena Bego, Anita Carević, Marija Čatipović, Lea Dujić, Ivana Grgić, Lana Periša, Marina Mandić, Dajana Radišić, Mirjana Strukan, Stjepan Vedran Vukasović, Vanja Županović.</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>45</td><td>0</td><td>45</td><td>0</td><td>0</td></tr>
<tr><td>Status of the course</td><td>obligatory</td><td>Percentage of application of e-learning</td><td colspan="5">10</td></tr>
<tr><td colspan="7">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="6">Training students for:
- application of mathematical concepts and tools from the area of linear algebra, vector calculus, analytic geometry, diferential calculus, analysis of real functions of real variable, sequences and series of numbers and functions, to solving engineering problems.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="6">Good knowledge of High School mathematics and passed State Exam in Mathematics.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="6">Students will be able to:
- state definitions and theorems from the enitre course,
- reproduce proofs of basic theorems,
- illustrate theorems with examples,
- solve systems of linear equations,
- apply vector calculus to analytical geometry of space,
- interpret derivatives mathematically, geometrically and physically,
- analyse functions of one variable,
- test convergence of sequences and series of numbers and functions.</td></tr>
<tr><td rowspan="5">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="4">Course content</td><td>L or S hours</td><td>AE hours</td></tr>
<tr><td colspan="4">1. Introduction. Relations. Functions. Sets of numbers, complex numbers, trigonometric form of complex number, Moivre formulas.</td><td>3</td><td>3</td></tr>
<tr><td colspan="4">2. Matrices. Basic operations with matrices. Matrix formulation of system of linear equations. Gaussian elimination. Linear independence and rank of a matrix. Kronecker-Capelli theorem.</td><td>3</td><td>3</td></tr>
<tr><td colspan="4">3. Inverse matrix. Determinants. Submatrices and subdeterminants. Laplace expansion of a determinant. Cramer's rule.</td><td>3</td><td>3</td></tr>
<tr><td colspan="4">4. Vectors. Basic operations with vectors. Coordinate system. Unit vector and cosines of directions. Linear independence of</td><td>3</td><td>3</td></tr>
</table>

	vectors and basis of a space. Scalar (dot) product, vector product and mixed product.		
	5. Equations of a line. Equations of a plane. Applications of analytic geometry.	3	3
	6. Functions of a real variable: defining function, classification of functions. Limits and continuity. Asymptotes. Review of elementary functions.	3	3
	7. Derivatives. Tangent and normal. Differential and approximate computation.	3	3
	8. Higher derivatives and differentials. Derivatve of a parametric function. Theorems of differential calculus (Fermat, Rolle, Cauchy, Lagrange). L'Hospital's rule and limits of undetermined forms.	3	3
	9. Monotonicity. Necessary and sufficient conditions for extrema. Geometrical extrema.	3	3
	10. Curvature. Sufficient condition for convexity and concavity. Necessary and sufficient conditions for inflection points. Examining functions and drawing graphs.	3	3
	11. Sequences of real numbers. Basic inequality of convergence. Accumulation point and sub-sequence. Boundedness, monotonicity and convergence. Properties of limits. Cauchy series. Some important limits.	3	3
	12. Series of real numbers. Sufficient condition for convergence. Convergence criteria. Absolute convergence. Alternating series.	3	3
	13. Sequences of functions. Series of functions. Power series and convergence radius. Differentiating series of functions. Taylor series and applications.	3	3
	List of laboratory or design exercises		LE or DE hours

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☒ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor ☐ (other)
Student responsibilities		

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	3	Research		Practical training	
	Experimental work		Report		Self study	3.6
	Essay		Seminar essay		(Other)	
	Tests	0.2	Oral exam		(Other)	
	Written exam	0.2	Project		(Other)	

<table>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="3">During semester two mid-term exams are held. The first exam is scheduled after 7 weeks of lectures, and the second in the week following the lectures. At each mid-term exam students can get 40 points, while the remaining 20 points are attained through assignements during lectures and excercises. The condition for passing the course is minimum 20 points on each mid-term exams and a total of at least 50 points. After semester, two final exams and a correction exam are held.

Students which did not pass one mid-term exam, can take only this part of the exam during final exams.

Student which did not pass any mid-term exam, take the final exam with comprehensive course content. In that case, masimum numbers of available points is 80. The condition for passing the course is minimum 40 points in the final exam and a total of at least 50 points. The grade is formed after the second final exam according to article 75 of the Statute of FESB:
15% of the best students get the mark excellent (5),
next 35% students get the mark very good (4),
next 35% students get the mark good (3), and
the last 15% students get thet mark sufficient (2).
Students who did not pass the course after final exams, and have obtained total of at leat 10 points, can attend the correction exam. On the correction exam maximal number of points is 100, and the minimum requirement for a passing grade is 50 points.
Mid-term exams, final exams and correction exams are held according to the exam schedule.</td></tr>
<tr><td rowspan="4">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>I. Slapničar, Matematika 1, FESB, Split, 2002.</td><td>20</td><td>http://www.fesb.unist.hr/mat1</td></tr>
<tr><td>I. Slapničar, J. Barić, M. Ninčević, Matematika 1 – zbirka zadataka, FESB, Split, 2010.</td><td>20</td><td>http://www.fesb.unist.hr/mat1</td></tr>
<tr><td>Lecture materials on FESB e-learning portal.</td><td></td><td>httpd://elearning.fesb.unist.hr</td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">- Petar Javor, Matematička analiza 1, Element, Zagreb, 2001.
- Luka Krnić i Zvonimir Šikić, Račun diferencijalni i integralni, I. dio, Školska knjiga, Zagreb, 1993.
- S. Pavasović i ostali, Matematika - riješeni zadaci, Građevinski fakultet, Split, 1999.
- B. P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1995.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">- homework
- short tests
- quizzes
- mid-term exams
- final exam
- student questionnaires</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

NAME OF THE COURSE	MATERIALS 1						
Code	FETC01	Year of study	1				
Course teacher	Dražen Živković, Ph. D., Full Professor Nikša Krnić, Ph.D. Associate Professor	Credits (ECTS)	6				
Associate teachers	Nikša Čatipović, Teaching assistant Zvonimir Dadić, Teaching assistant	Type of instruction (number of hours)	L	S	AE	LE	DE
			45	0	0	30	0
Status of the course	Obligatory	Percentage of application of e-learning	0				

COURSE DESCRIPTION

Course objectives	- Present basic knowledge about material structures, - Introduce students with mechanical properties and their relationship to the structure of the material. - Explain the mechanical properties testing, both to materials and completed construction, - Provide knowledge about basic methods of detection of errors in materials and metal structures. - Present basic alloys phase diagrams, especially Fe - C alloys phase diagrams, as well as the properties of iron alloys		
Course enrolment requirements and entry competences required for the course	None		
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - Analyze the processes of crystallization and the specifics of metastable and stable crystallization of Fe-C alloy - Explain the second test procedures basic mechanical properties of materials - Characterize polymer and composite materials - Analyze properties and areas of application of steel, casting and non-ferrous metals - Use the principles of optical microscopy - Explain methods of testing materials and structures without damage		
Course content broken down in detail by weekly class schedule (syllabus)	Course content	L hours	AE hours
	The types of materials, recognition of materials, atomic structures, atomic bonds	3	0
	Crystal lattice, crystalline lattice inperfections	3	0
	The crystallization process, the rate of crystal formation and crystal growth, resolution (micro and macro), allotrope modification, Curie point	3	0
	The deformation (elastic, plastic), sliding deformation, twins process, speed and degree of deformation, deformation in hot and cold condition, isotropy, anisotropy	3	0
	Alloy cooling curves, Solubility - complete solubility diagram	3	0
	Eutectic phase diagram, Peritectic phase diagram	3	0
	Fe- C alloy phase diagrams	3	0
	First midterm exam		
	Mechanical properties, Tensile strength test	3	0
	Dynamic strength, Hardness test methods	3	0

	Toughness, Creep, Non-destructive material testing (visual, penetrating liquids)	3	0
	Magnetic method testing, Ultrasound testing	3	0
	X and Y-ray testing, Chemical composition examination	3	0
	Steels, Fe casts	3	0
	Second midterm exam		
	List of laboratory or design exercises		LE hours
	The types of materials, recognition of materials,		2
	Pure metal heating and cooling curve		2
	Complete solubility diagram, Allotrope modification		2
	Eutectic phase diagram		2
	Stable Fe-C phase diagram		2
	Metastable Fe-Fe_3C phase diagram, Curie point		2
	Comparison Fe-C – Fe_3C phase diagrams, Metallography of Fe alloys		2
	First midterm exam		
	Mechanical properties, Tensile strength test		2
	Dynamic strength testing, Toughness testing, Sparks testing		2
	Hardness testing (Brinell, Vickers, Rockwell)		2
	Hardness testing (Poldy, Shore, Leeb)		2
	Magnetic method testing, Penetrating liquid testing		2
	Ultrasonic testing, X and Y ray testing		2
	Second midterm exam		

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☒ multimedia ☒ laboratory ☐ work with mentor ☐ (other)
Student responsibilities	The presence in lectures and exercises in the amount of at least 70%. Performed all required laboratory exercises.	

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	1,5	Research		Practical training	
	Experimental work		Report		Self-directed learning	3,5
	Essay		Seminar essay		Laboratory exercises	1,0
	Tests		Oral exam		(Other)	
	Written exam		Project		(Other)	

Grading and evaluating student work in class and at the final exam	During the semester there will be two mid-term exams (tests). The first mid-term, after 7 weeks of classes and the second after the next 6 weeks of classes. At the final exam students have to take part material that did not pass the mid-term. Each test is carried out as written exam lasting 45 minutes. Usually it consists of 10 test questions and the two tasks. The requirements for a positive evaluation are: positive assessment of laboratory exercises and 50% points on each test. The final grade is based on the resulting percentage on mid-term exams. Percentage - Rating 50% to 61% - sufficient (2) 62% to 74% - good (3) 75% to 87% - very good (4) 88% to 100% - excellent (5) Examinations according to the Faculty schedule! The final grade is determined after the second final exam, applying the relative ECTS grading system in accordance with the study rules and study system of the University

<table>
<tr><td></td><td colspan="3">of Split. A group of students who passed the exam is divided into four sub-groups: 15% of the best students are graded excellent, 35% following very good, the next 35% a good grade and the last 15% positive grade. Students who did not pass the exam after two final exams have the last chance to pass exam in the autumn period where they can get a positive grade. Overall material has to be passed at last possible exam. The written exam consists of test with 20 questions and three tasks. The exam lasts 90 minutes.</td></tr>
<tr><td rowspan="6">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>D. Živković, the author's lecture, FESB</td><td></td><td>E-learning portal</td></tr>
<tr><td>R. Deželić, Meterijali (I dio), FESB Split, 1998.</td><td>10</td><td></td></tr>
<tr><td>F. Kovačiček, Đ. Španiček, Materijali – osnove znanosti o mmaterijaliam, FSB Zagreb, 2000.</td><td>2</td><td></td></tr>
<tr><td>M. Franz, Svojstav materijala 2005.</td><td>5</td><td></td></tr>
<tr><td>B. Anzulović, Materijali, Split, 1993.</td><td>3</td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">T.Filetin, F.Kovačiček, J. Indof, Svojstva i primijena materijala, FSB Zagreb, 2002.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">– Evaluation of results in accordance with the above learning outcomes
– Feedback from students via surveys
– Self-evaluation of teachers
– Institutional and non-institutional evaluations</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

NAME OF THE COURSE	PHYSICS						
Code	FEMC03	Year of study	1.				
Course teacher	Ilja Doršner, Ph.D., Associate Professor	Credits (ECTS)	4				
Associate teachers		Type of instruction (number of hours)	L	S	AE	LE	DE
			45	0	0	0	0
Status of the course	Obligatory	Percentage of application of e-learning	0				

COURSE DESCRIPTION

Course objectives	Training students for: - understanding of basic laws of classical physics; - ability to apply laws of classical physics to real-life problems.		
Course enrolment requirements and entry competences required for the course	None		
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: 1. to present basic laws of mechanics, fluid statics and dynamics, thermodynamics, oscillations, waves, electromagnetism, optics and the structure of atoms. 2. to demonstrate problem solving in the area of these physical units. 3. to perform more complex conclusions from fundamental physical principles in the mentioned units. 4. to analyse real physical problems in these units. 5. to present physical concepts and solutions of real problems in the mentioned areas. 6. to interpret physical processes in the areas of mechanics, fluid statics and dynamics, thermodynamics, oscillations, waves, electromagnetism, optics and the structure of atoms.		
Course content broken down in detail by weekly class schedule (syllabus)	Course content	L hours	AE hours
	Physical quantities and units. Vectors and scalars. Basic introduction to the calculus.	3	0
	Particle kinematics.	3	0
	Newton's laws, friction force.	3	0
	Work, power, energy. The movement of system of particles and rigid bodies.	3	0
	Gravity, gravitational potential energy.	3	0
	Fluid statics and dynamics.	3	0
	Heat and thermodynamics.	3	0
	Harmonic oscillations.	3	0
	Mechanical waves, sound waves, ultrasound.	3	0
	Electromagnetic waves.	3	0
	Geometrical and physical optics.	3	0
	The quantum nature of light.	3	0
	The structure of atoms.	3	0
Format of instruction	☒ lectures ☐ seminars and workshops ☐ exercises ☐ *on line* in entirety	☐ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor	

<table>
<tr><td></td><td colspan="6">☐ partial e-learning
☐ field work</td><td colspan="2">☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="8"></td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1,5</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Individual work</td><td>2,1</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td>0,2</td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td>0,2</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="8">There are two midterm exams, two final exams and one make-up exam. The first midterm exam is after 7 weeks of lectures and the second one is after the next 6 weeks. Each midterm test consists of the following 6 questions:
2 obligatory questions (basic course questions);
4 additional questions that test the theory and problem solving knowledge.
The requirement for passing grade at the midterm exams is to have at least 90% from each obligatory question and at least 50% from each of remaining 4 questions. Students that do not pass one of the midterm exams can retake it during the final exams. Final exams lasts consist out of the following 12 questions:
4 obligatory questions (basic course questions);
8 additional questions that test the theory and problem solving knowledge.
The requirement for passing grade at the final exam is to have at least 90% from each of obligatory questions and at least 50% from each of remaining 8 questions.
Final grade is determined using the relative grading system based on the arithmetic mean of the per cents of each of the additional questions. Obligatory questions do not enter the arithmetic mean. Students that have passed both midterm exams or final exams are grouped in four categories: 15% of the students with the highest arithmetic means are assigned grade A (excellent), 35% of the students with the next best arithmetic means are assigned grade B (very good), 35% of the students with the next to next best arithmetic means are assigned grade C (good), and 15% of the students with the lowest passing arithmetic means are assigned grade D (satisfactory).
Students who fail to pass the course through midterms and/or final exams have one make-up exam at the beginning of fall. This exam features the same format as the final exam.
Exam schedule is predetermined through the academic calendar.</td></tr>
<tr><td rowspan="4">Required literature (available in the library and via other media)</td><td colspan="5">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="5">D. Lelas: Online materials, E-learning portal of FESB</td><td></td><td></td></tr>
<tr><td colspan="5">Kulišić, P.: Mehanika i toplina, Školska knjiga, Zagreb, 1995. (in Croatian)</td><td></td><td></td></tr>
<tr><td colspan="5">V. Henč-Bartolić, Kulišić, P.: Valovi i optika, Školska knjiga, Zagreb, 1995. (in Croatian)</td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="8">- D. Halliday, R. Resnick, J. Walker: Fundamental of Physics, 7th Edition, John Wiley & Sons, Inc., 2005; N. Cindro: Fizika 1, Školska knjiga, Zagreb, 1991; C. Kittel, W. D. Knight, M. A. Ruderman: Udžbenik Sveučilišta u Berkeleyu, Svezak 1, Mehanika, Tehnička knjiga, Zagreb, 1992.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="8">- Student evaluation surveys
- Teacher self-evaluation
- Institutional and non-institutional evaluations</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="8"></td></tr>
</table>

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="6">MATHEMATICS 2</td></tr>
<tr><td>Code</td><td>FEMX02</td><td>Year of study</td><td colspan="5">1</td></tr>
<tr><td>Course teacher</td><td>Ivan Slapničar, Ph.D., Full Professor,
Anita Matković, Ph.D., Associate Professor,
Josipa Barić, Ph.D., Assistant Professor.</td><td>Credits (ECTS)</td><td colspan="5">7</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Ph.D. Nevena Jakovčević Stor, Irena Bego, Anita Carević, Marija Čatipović, Lea Dujić, Ivana Grgić, Lana Periša, Marina Mandić, Dajana Radišić, Mirjana Strukan, Stjepan Vedran Vukasović, Vanja Županović.</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>45</td><td>0</td><td>45</td><td>0</td><td>0</td></tr>
<tr><td>Status of the course</td><td>obligatory</td><td>Percentage of application of e-learning</td><td colspan="5">10</td></tr>
<tr><td colspan="7">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="6">Training students for:
- application of mathematical concepts and tools from the area of integral calculus, ordinary differential equations, functions of several variables and multiple integrals, to analyze and solve engineering problems.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="6">Good knowledge of High School mathematics and passed State Exam in Mathematics.</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="6">Students will be able to:
1. state definitions and theorems from the enitre course,
2. reproduce proofs of basic theorems,
3. illustrate theorems with examples,
4. identify integrals which are elementary integrable and solve them.
5. solve ordinary differential equations and systems of differential equations.
6. apply differential equations to model population growth, heat conduction, the oscillator and the predator-prey system.
7. identify quadratic surfaces
8. analyze the extrema of real functions of several variables.
9. apply a single and multiple definite integrals to computation of area, curve length, volume and center of gravity in the standard coordinate systems.</td></tr>
<tr><td rowspan="6">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="4">Course content</td><td>L or S hours</td><td>AE hours</td></tr>
<tr><td colspan="4">1. Indefinite integrals. Definition and basic properties. Table of basic integrals. Basic techniques of integration.</td><td>3</td><td>3</td></tr>
<tr><td colspan="4">2. Integration of rational functions. Integration of trigonometric functions. Recursive formulae.</td><td>3</td><td>3</td></tr>
<tr><td colspan="4">3. Integration of some irrational functions. Integrating a series of functions. Application of integrals to free fall with air resistance problem.</td><td>3</td><td>3</td></tr>
<tr><td colspan="4">4. Definite integrals. Definition and basic properties. Newton-Leibnitz formulae. Techniques of integration. Improper integrals.</td><td>3</td><td>3</td></tr>
<tr><td colspan="4">5. Application of definite integrals - the length of arc planar curve, volume and surface area of the rotating body. Numerical integration – trapezoid rule, Simpson’s rule, Richardson extrapolation.</td><td>3</td><td>3</td></tr>
</table>

	6. The functions of several variables. Definition and basic properties. Domain of the function. Limits and continuity. Quadratic surfaces.	3	3
	7. Partial derivatives. Differentiability. Tangent plane. Extrema of functions of several variables. Conditional extrema.	3	3
	8. Multiple integrals. Basic concepts and definitions. Double integral. Double integral in polar coordinates. Applications of double integral.	3	3
	9. Triple integral. Triple integral in cylindrical and spherical coordinates. Change of variables in multiple integrals.	3	3
	10. Introduction to Differential Equations. Basic concepts and definitions. Examples: modeling population growth, logistic equation, equation of heat conduction, Hooke's law. Equations with separable variables.	3	3
	11. Homogeneous differential equations. Exact differential equations. Integration factor. Linear differential equations of the first order.	3	3
	12. Bernoulli differential equation. Euler method as numerical procedure for solving linear differential equations. Differential equations of second order.	3	3
	13. Linear differential equations of second order with constant coefficients. Example: electronic circuits - harmonic oscillator. Systems of differential equations. Lotka-Volterra equations for predator-prey system.	3	3
	List of laboratory or design exercises		LE or DE hours

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☒ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor ☐ (other)
Student responsibilities		

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	3	Research		Practical training	
	Experimental work		Report		Self study	3.6
	Essay		Seminar essay		(Other)	
	Tests	0.2	Oral exam		(Other)	
	Written exam	0.2	Project		(Other)	

Grading and evaluating student work in class and at the final exam	During semester two mid-term exams are held. The first exam is scheduled after 7 weeks of lectures, and the second in the week following the lectures. At each mid-term exam students can get 40 points, while the remaining 20 points are attained through assignements during lectures and excercises. The condition for passing the

<table>
<tr><td></td><td colspan="3">course is minimum 20 points on each mid-term exams and a total of at least 50 points.
After semester, two final exams and a correction exam are held.
Students which did not pass one mid-term exam, can take only this part of the exam during final exams.

Student which did not pass any mid-term exam, take the final exam with comprehensive course content. In that case, maximum numbers of available points is 80. The condition for passing the course is minimum 40 points in the final exam and a total of at least 50 points. The grade is formed after the second final exam according to article 75 of the Statute of FESB:
15% of the best students get the mark excellent (5),
next 35% students get the mark very good (4),
next 35% students get the mark good (3), and
the last 15% students get thet mark sufficient (2).

Students who did not pass the course after final exams, and have obtained total of at least 10 points, can attend the correction exam. On the correction exam maximal number of points is 100, and the minimum requirement for a passing grade is 50 points.

Mid-term exams, final exams and correction exams are held according to the exam schedule.</td></tr>
<tr><td rowspan="6">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>I. Slapničar, Matematika 2, skripta, FESB, Split</td><td></td><td>http://www.fesb.unist.hr/mat2</td></tr>
<tr><td>Lecture materials on FESB e-learning portal.</td><td></td><td>https://elearning.fesb.unist.hr</td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">- Petar Javor, Matematička analiza 2, Element, Zagreb, 2000.
- Luka Krnić i Zvonimir Šikić, Račun diferencijalni i integralni, I. dio, Školska knjiga, Zagreb, 1993.
- B. P. Demidovič, Zadaci i riješeni primjeri iz više matematike s primjenom na tehničke nauke, Tehnička knjiga, Zagreb, 1995.
- Dž. Lugić, Matematika II: metodički riješeni zadaci i kratki pregled definicija i teorema, FESB, 1999.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">- homework
- short tests
- quizzes
- mid-term exams
- final exam
- student questionnaires</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

NAME OF THE COURSE	MECHANICS OF MATERIALS 1						
Code	FESC05	Year of study	1.				
Course teacher	Frane Vlak, Ph.D., Associate Professor	Credits (ECTS)	6				
Associate teachers	Marko Vukasović, Ph.D., Teaching assistant Branka Bužančić Primorac, Ph.D., Teaching assistant Maja Kovačić, Teanhing assistant	Type of instruction (number of hours)	L	S	AE	LE	DE
			45	0	30	0	0
Status of the course	Obligatory	Percentage of application of e-learning	0				

COURSE DESCRIPTION

Course objectives	Training students for: - understanding and application of basic laws of solid body mechanics, - introducing to stress and strain distribution in the beams under different types of loading (axial, torsion, bending, shear and combined loading).		
Course enrolment requirements and entry competences required for the course	Statics (Mechanics 1)		
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: 1. explain plane stress, plane strain and stress-strain relationship (Hooke's law), 2. analyse plane stress using Mohr's circle, 3. calculate geometrical properties of cross sections, 4. determine stress and displacements of beams under tension/compression, torsion and bending, 5. apply developed procedures to analyse and design simple structures (allowable stress and strain design), 6. solve statically indeterminate problems using the method of integration of the deflection curve and the method of equating displacements , 7. analyse beams under combined loadings using failure theories, 8. solve simple problems of buckling of columns.		
Course content broken down in detail by weekly class schedule (syllabus)	Course content	L hours	AE hours
	Introduction to mechanics of materials. Problems and methods of mechanics of materials. Modelling of structures. Stress vector, normal and shear stress. Stress tensor. Stress transformation.	3	2
	Principal stresses. Mohr's circle for plane stress. Strain, normal strain, shear strain and dilatation. Strain tensor. Strain transformation. Mohr's circle for plane strain.	3	2
	Stress-strain relationship. Experimental data for technical materials.Hooke's law for uniaxial stress state. Plane stress state. Relationship between elasticity constants. Relationship between internal force components and stress components. General approach to problems of mechanics of materials.	3	2
	Geometrical properties of plane areas, first and second moment of area. Parallel axis theorem. Transformation of second moments of area under rotation of coordinate system. Mohr's circle for second moments of area. Radius of gyration.	3	2
	Tension/compression. Prismatic beams and beams with varying cross sectional area. Displacement diagram. Stress concentration.	3	2

	Torsion of circular beams. Assumptions and constraints. Shear stress and strain. Allowable stress design. Bending. Assumptions and constraints.	3	2
	Pure bending. Transverse bending. Allowable stress design. Unsymmetric bending.	3	2
	First midterm exam		
	Differential equation of the deflection curve. Moment-area method. Stresses and strains of beams with nonuniform cross sections.	3	2
	Bending of thick curved beams. Shear. Influence of the shear on beam deflection.	3	2
	Statically indeterminate problems in tension/compression. Thermal effects, misfits and prestrains. Statically indeterminate problems in torsion. Statically indeterminate problems in bending.	3	2
	Strain energy. Failure theories.	3	2
	Failure theories for combined loading problems.	3	2
	Buckling of columns. Elastic and inelastic buckling. Design formulas for columns.	3	2
	Second midterm exam		

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☒ multimedia ☐ laboratory ☐ work with mentor ☐ (other)
Student responsibilities	The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises.	

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	2,5	Research		Practical training	
	Experimental work		Report		Individual work	3,2
	Essay		Seminar essay		Laboratory exercises	
	Tests	0,2	Oral exam		Preparation for laboratory exercises	
	Written exam	0,1	Project		(Other)	

Grading and evaluating student work in class and at the final exam	There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. In the final exams students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests. Grade (in percentage) is formed according to the formula: Grade(%) = 0,5 (M1 + M2) the activities in percentage: • M1, M2 – test results.

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Alfirević, I: Nauka o čvrstoći I, Tehnička knjiga, Zagreb, 1989.	5	
	F. Vlak: Autorizirana predavanja, FESB		e-learning portal

Optional literature (at the time of submission of study programme proposal)	Craig, R., R.: Mechanics of Materals, John Wiley & Sons, New York, 2000.
Quality assurance methods that ensure the acquisition of exit competences	– Evaluation of results in accordance with the above learning outcomes – Feedback from students via surveys – Self-evaluation of teachers – Institutional and non-institutional evaluations
Other (as the proposer wishes to add)	

NAME OF THE COURSE	**THERMODYNAMICS 1**						
Code	FESC06	Year of study	2				
FESC06	Nižetić Sandro, Ph.D. Associate Professor	Credits (ECTS)	7				
Nižetić Sandro Ivan Tolj Dario Bezmalinović Grubišić-Čabo Filip	Ivan Tolj, Ph.D., Teaching assistant Dario Bezmalinović, Ph.D., Teaching assistant	Type of instruction (number of hours)	L	S	AE	LE	DE
			45	0	30	0	0
	Obligatory	Percentage of application of e-learning					
Obavezni							
Course objectives	Training students for: - Specify (list) basic thermodynamic terms and notations and apply general thermodynamic laws.						
Course enrolment requirements and entry competences required for the course	None.						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: 1. Classify and consider; basic thermodynamic terms, external influences and properties of state and connect them with causal relationship for considered property or analysed system, 2. Describe and implement general thermodynamic laws for specific properties or systems, 3. Implement thermodynamic charts for real properties to calculate their properties of state (values), 4. Consider and compute; flow systems, right and left ideal gas cycles and calculate heat to work efficiency, 5. Consider maximal work and calculate exergy flows.						
Course content broken down in	Course content		L or S hours		AE hours		

detail by weekly class schedule (syllabus)	Introduction to the thermodynamics. External influences. Temperature, pressure and heat. Observer's aspect.	3 hours	2 hours
	Ideal gas equation and ideal gas mixtures.	3 hours	2 hours
	Equivalency of heat and work.	3 hours	2 hours
	Internal energy and First law of thermodynamics.	3 hours	2 hours
	Equilibrium polytropes.	3 hours	2 hours
	Ideal gas cycles and implementation of polytropes.	3 hours	2 hours
	Second law of thermodynamics.	3 hours	2 hours
	Analytical formulation of the second law of thermodynamics for reversible and irreversible processes.	3 hours	2 hours
	Entropy and statistical interpretation.	3 hours	2 hours
	Maximal work.	3 hours	2 hours
	Flow processes and implementation.	3 hours	2 hours
	Exergy analysis.	3 hours	2 hours
	Real properties, properties charts, Clapeyron-Clausiusova equation, Van der Waalsova equation.	3 hours	2 hours
	Properties curves for real gases, real gas power cycles.	3 hours	2 hours
	Left right cycles, refrigeration cycles and gas liquefaction.	3 hours	2 hours

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☒ independent assignments ☒ multimedia ☐ laboratory ☐ work with mentor ☐ (other)
Student responsibilities	The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required auditorium exercises.	

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	2,5	Research	4,5	Practical training	
	Experimental work		Report		(Other)	
	Essay		Seminar essay		(Other)	
	Tests		Oral exam		(Other)	
	Written exam		Project		(Other)	
Grading and evaluating student						

<table>
<tr><td>work in class and at the final exam</td><td colspan="3"></td></tr>
<tr><td rowspan="6">Required literature (available in the library and via other media)</td><td>Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td>Nižetić, S. : Online predavanja dostupna na E-learning portalu, (2010)</td><td></td><td></td></tr>
<tr><td>Bošnjaković F.: Nauka o toplini I, tehnička knjiga, Zagreb 1978.</td><td>2</td><td></td></tr>
<tr><td>Y. A. Cengel, M.A.Boles, Thermodynamics, 4th Edition,McGrawHill, 2002.</td><td>1</td><td></td></tr>
<tr><td>Fabris O: Osnove inženjerske termodinamike, Pomorski fakultet u Dubrovniku, Dubrovnik 1994.</td><td></td><td></td></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">–Ražnjević K.: Toplinske tablice, Aksiom, Zagreb 2000.
–Paić M.: Toplina i termodinamika, školska knjiga, Zagreb 1994.
–Zemansky, M.W., Dittman B.H.: heat and Thermodynamics, McGraw Hill Book Company, London 1987.
–Ninić N.: Uvod u termodinamiku i njene tehničke primjene, Sveučilište u Splitu, FESB, (2008)
– Baehr H.D.: Thermodynamik, Springer Verlag. Berlin 1984.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">- Evaluation of results in accordance with the above learning outcomes
- Feedback from students via surveys
- Self-evaluation of teachers
- Institutional and non-institutional evaluations</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

<table>
<tr><td>NAME OF THE COURSE</td><td colspan="7">COMPUTER- AIDED ANALYSIS</td></tr>
<tr><td>Code</td><td>FESC22</td><td>Year of study</td><td colspan="5">2</td></tr>
<tr><td>Course teacher</td><td>Damir Vučina, Ph.D.,Full Professor</td><td>Credits (ECTS)</td><td colspan="5">5</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Igor Pehnec, Ph.D., Asistant Professor
Ivo Marinić- Kragić, Teaching assistant</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>AE</td><td>LE</td><td>DE</td></tr>
<tr><td>30</td><td>0</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Status of the course</td><td>Obligatory</td><td>Percentage of application of e-learning</td><td colspan="5">0</td></tr>
<tr><td colspan="8">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="7">Acquiring theoretical know-how in basic numerical methods in engineering.
Developing competences in modeling engineering problems for numerical methods.
Developing practical skills in developing C and Matlab code for engineering problems.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="7">Competences acquired in courses Mathematics I, Mechanics I</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="7">After completing the course, students will be able to:
Explain the basic setup of computers,
Describe the procedure of developing programs,
C language: characterize the properties of syntax elements
Categorize the properties of numerical procedures
Develop flowcharts for simpler problems
Numerically model simpler engineering problems
Create and apply basic methods of numerical analysis for: solving linear systems, nonlinear equations, integration, differentiation, interpolation, approximation
Develop and test own programs in C</td></tr>
<tr><td rowspan="15">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="5">Course content</td><td>L hours</td><td>AE hours</td></tr>
<tr><td colspan="5">Introduction to computers, binary system, logic functions. Introduction to computer-aided analysis.</td><td>2</td><td></td></tr>
<tr><td colspan="5">Basics of numerical procedures and analysis, simple algorithms.</td><td>2</td><td></td></tr>
<tr><td colspan="5">C-language programming part 1</td><td>2</td><td></td></tr>
<tr><td colspan="5">C-language programming part 2</td><td>2</td><td></td></tr>
<tr><td colspan="5">Developing flowcharts and pseudo-code, part 1</td><td>2</td><td></td></tr>
<tr><td colspan="5">Developing flowcharts and pseudo-code, part 2</td><td>2</td><td></td></tr>
<tr><td colspan="5">Elementary numerical procedures and engineering applications (mechanics, fluid mechanics, thermodynamics)</td><td>2</td><td></td></tr>
<tr><td colspan="5">Engineering application of numerical methods: Solving linear systems</td><td>2</td><td></td></tr>
<tr><td colspan="5">Engineering application of numerical methods: Solving nonlinear equations and systems.</td><td>2</td><td></td></tr>
<tr><td colspan="5">Engineering application of numerical methods: Interpolation by polinomials and piecewise polynomials</td><td>2</td><td></td></tr>
<tr><td colspan="5">First midterm exam</td><td></td><td></td></tr>
<tr><td colspan="5">Engineering application of numerical methods: Approximation using polinomials.</td><td>2</td><td></td></tr>
</table>

	Engineering application of numerical methods: Numerical differentiation and integration. Search and optimization-basics.	2	
	Examples of setting up physical and mathematical models for different engineering problems. Development of corresponding algorithms and computer programs in C-language and MATLAB.	2	
	Second midterm exam		
	List of laboratory exercises		LE hours
	Visual studio, workspace, compiler, linker. Basic terms of C, Types, operators, expressions. printf().		2
	Declaring variables, formatted output, data input. scanf().		2
	Conditional expresions. Branching, if, if-else, if-else if-...-else		2
	Loops, while(), do-while(), for().		2
	Files, fopen(), fprintf(), fscanf(), feof().		2
	Arrays, 1D, 2D		2
	Functions, declaration, definition, passing arguments		2
	Pointers. Passing by value and by reference		2
	Introduction to numerical methods. Interpolation		2
	Introduction to numerical methods. Non-linear equations, successive halving and Newton's method		2
	Introduction to numerical methods. Integration, trapezoid quadrature, Simpson's method.		2
	Basics of MATLAB. Differences to C. Basic syntax.		2
	Numerical methods in MATLAB		2

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia ☒ laboratory ☐ work with mentor ☐ (other)
Student responsibilities	The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises.	

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	3	Research		Practical training	
	Experimental work		Report		Individual work	2
	Essay		Seminar essay		Laboratory exercises	
	Tests		Oral exam		Preparation for laboratory exercises	
	Written exam		Project		(Other)	

Grading and evaluating student work in class and at the final exam	There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm test consists of respective theoretical questions and numerical problems. The final tests consist of overall theoretical questions and numerical problems. In the final exams, students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises and 50 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula: Grade(%) = 0,5 (M1 + M2) the activities in percentage: • M1, M2 – test results.

	Title	Number of copies in the library	Availability via other media
Required literature (available in the library and via other media)	D. Vučina, "Primjena računala u inženjerskoj analizi", Sveučilište u Splitu, FESB, Split, 2007		
	I. Pehnec, materijali za vježbe		
Optional literature (at the time of submission of study programme proposal)	Željan Lozina, 'Uvod u programiranje', Sveučilište u Splitu, 2005 S. C. Chapra, R.P. Canale, "Numerical Methods for Engineers", McGraw-Hill 2006 G. Lindfield, J. Penny, "Numerical Methods using MATLAB ", Ellis Horwood 1995 W.Cheney, D. Kincaid, 'Numerical mathematics and computing', Brooks/Cole 2008		
Quality assurance methods that ensure the acquisition of exit competences	– Evaluation of results in accordance with the above learning outcomes – Feedback from students via surveys – Self-evaluation of teachers – Institutional and non-institutional evaluations		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	**MECHANICS OF MATERIALS 2**						
Code	FESC08	Year of study	2.				
Course teacher	Frane Vlak, Ph.D., Associate Professor	Credits (ECTS)	5				
Associate teachers	Marko Vukasović, Ph.D., Teaching assistant	Type of instruction (number of hours)	L	S	AE	LE	DE
			30	0	30	0	0
Status of the course	Obligatory	Percentage of application of e-learning	0				
COURSE DESCRIPTION							
Course objectives	Training students for: - understanding and application of basic laws of structural analyses, - introducing to energy methods: the force method, the displacement method and method of initial parameters, - introducing to thin circular plates analysis.						
Course enrolment requirements and entry competences required for the course	Statics (Mechanics 1) and Mechanics of materials 1.						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - explain generalized force and displacement, flexibility and stiffness matrix, strain energy of beams, - explain Betti's theorem, Maxwell's theorem, Castigliano's theorems and theorems of minimum potential energy						

<table>
<tr><td></td><td colspan="4">- apply Castigliano's theorems to plane beam structures (frames),
- determine statical and kinematical indeterminancy of beam structures,
- combine symmetry and antisymmetry of beam structures,
- explain basic system of the force method and the canonical equations of the force method ,
- apply the force method to beam structures,
- explain basic system of the displacement method and the canonical equations of the displacement method,
- apply the displacement method to beam structures,
- explain the method of initial parameters,
- apply the method of initial parameters in the analysis of the displacements and internal force components,
- calculate stresses and internal force components of thin circular plates.</td></tr>
<tr><td rowspan="16">Course content broken down in detail by weekly class schedule (syllabus)</td><td>Course content</td><td>L hours</td><td>AE hours</td></tr>
<tr><td>Work. Generalized force and displacement. Work-energy principle. Flexibility coefficients. Flexibility matrix. Stiffness coefficients. Stiffness matrix. Strain energy. Elastic strain energy for various types of loading. Clapeyron's theorem.</td><td>2</td><td>2</td></tr>
<tr><td>Betti's theorem. Maxwell's theorem. Castigliano's theorems. Mohr's integral. Vereschagin's rule. Theorem of minimum potential energy. Theorem of minimum complementary potential energy.</td><td>2</td><td>2</td></tr>
<tr><td>Types of beam structures. Degree of freedom. Statical indeterminancy. Kinematical indeterminancy.</td><td>2</td><td>2</td></tr>
<tr><td>Symmetry and antisymmetry of beam structures.</td><td>2</td><td>2</td></tr>
<tr><td>Basic system of the force method. Symmetrical basic systems.</td><td>2</td><td>2</td></tr>
<tr><td>Canonical equations of the force method.</td><td>2</td><td>2</td></tr>
<tr><td>Basic system of the displacement method.</td><td>2</td><td>2</td></tr>
<tr><td>First midterm exam</td><td></td><td></td></tr>
<tr><td>Symmetrical basic systems for displacement method.</td><td>2</td><td>2</td></tr>
<tr><td>Canonical equations of the displacement method.</td><td>2</td><td>2</td></tr>
<tr><td>Method of initial parameters. State vector. Field matrix. Load vector.</td><td>2</td><td>2</td></tr>
<tr><td>Several load distributions. Statical indeterminate problems.</td><td>2</td><td>2</td></tr>
<tr><td>Bending of thin circular plates.</td><td>2</td><td>2</td></tr>
<tr><td>Membrane stresses in axisymmetric shells. Thick walled pressure vessels.</td><td>2</td><td>2</td></tr>
<tr><td>Second midterm exam</td><td></td><td></td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work
☒ independent assignments
☒ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="3">The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises.</td></tr>
<tr><td rowspan="4">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is</td><td>Class attendance</td><td>2,0</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Individual work</td><td>2,2</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>0,5</td><td>Laboratory exercises</td><td></td></tr>
<tr><td>Tests</td><td>0,2</td><td>Oral exam</td><td></td><td>Preparation for laboratory exercises</td><td></td></tr>
</table>

<table>
<tr><td>equal to the ECTS value of the course)</td><td>Written exam</td><td>0,1</td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. In the final exams students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests. Grade (in percentage) is formed according to the formula:
Grade(%) = 0,45 (M1 + M2) + 0,1S
the activities in percentage:
• M1, M2 – test results,
• S - seminar essey.</td></tr>
<tr><td rowspan="5">Required literature (available in the library and via other media)</td><td colspan="3">Title</td><td>Number of copies in the library</td><td colspan="2">Availability via other media</td></tr>
<tr><td colspan="3">Alfirević, I.: Nauka o čvrstoći II, Sveučilište u Zagrebu, Fakultet strojarstva i brodogradnje, Zagreb, 1999.</td><td>5</td><td colspan="2"></td></tr>
<tr><td colspan="3">Pavazza, R.; Uvod u analizu tankostjenih štapova, Zagreb, 2007.</td><td>3</td><td colspan="2"></td></tr>
<tr><td colspan="3"></td><td></td><td colspan="2"></td></tr>
<tr><td colspan="3"></td><td></td><td colspan="2"></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">– Parnes, R.: Solid Mechanics, John Wiley & Sons, Chichester, 2001.
– Solecky, R., Conant, R. J.: Advanced Mechanics of Materials, Oxford University Press, New York, Oxford, 2003.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="6">– Evaluation of results in accordance with the above learning outcomes
– Feedback from students via surveys
– Self-evaluation of teachers
– Institutional and non-institutional evaluations</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="6"></td></tr>
</table>

NAME OF THE COURSE	THERMODYNAMICS 2						
Code	FESC09	Year of study	1				
FESC06	Nižetić Sandro, Ph.D. Associate Professor	Credits (ECTS)	7				
Nižetić Sandro Ivan Tolj Dario Bezmalinović Grubišić-Čabo Filip	Ivan Tolj, Ph.D. Teaching assistant Dario Bezmalinović, Ph.D. Teaching assistant	Type of instruction (number of hours)	L	S	AE	LE	DE
			45	0	30	0	0
	Obligatory	Percentage of application of e-learning					
Obavezni							

Course objectives	Training students for: - Specify (list) and describe general heat transfer mechanisms, - Implement general heat transfer laws (mechanisms) for properties and systems, - Analyse and compute: combustion process, heat exchangers, and properties state change for moist air.		
Course enrolment requirements and entry competences required for the course	Thermodynamics 1, Mathematics 1 and Mathematics 2.		
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: 1. Classify and implement basic heat transfer mechanisms, 2. Classify and compute basic parameters for heat exchangers, 3. Demonstrate and compute processes in the charts for moist air, 4. Analyse and elaborate general combustion processes, 5. Analyse and elaborate general flow processes and laws.		
Course content broken down in detail by weekly class schedule (syllabus)	Course content	L or S hours	AE hours
	Introduction to the heat transfer. Heat conduction (stationary case).	3 hours	2 hours
	Nonstationary heat conduction. Introduction to the heat convection.	3 hours	2 hours
	Convective heat transfer.	3 hours	2 hours
	Introduction to the thermal radiation, general thermal radiation laws.	3 hours	2 hours
	Heat transfer by thermal radiation – analysis of specific cases.	3 hours	2 hours
	Heat transfer (fluid to fluid), introduction to heat exchangers.	3 hours	2 hours
	Heat exchangers.	3 hours	2 hours
	Introduction to the moist air, properties of the moist air, Moliere h-x properties chart.	3 hours	2 hours
	Properties change curves for moist air.	3 hours	2 hours

	Drying process, drying processes, water evaporation.	3 hours	2 hours
	Introduction to the combustion, stoichiometric ratio.	3 hours	2 hours
	Combustion products analysis, gross and net calorific value, theoretical and real combustion temperature, and Moliere h-x properties chart for combustion analysis.	3 hours	2 hours
	Introduction to the flow processes, elementary flow equations.	3 hours	2 hours
	Laval nozzle and flow processes, turbine work.	3 hours	2 hours
	Introduction to the binary mixtures, evaporation and liquefaction processes (distillation).	3 hours	2 hours

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☒ independent assignments ☒ multimedia ☐ laboratory ☐ work with mentor ☐ (other)
Student responsibilities	The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required auditorium exercises.	

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	2	Research	3	Practical training	
	Experimental work		Report		(Other)	
	Essay		Seminar essay		(Other)	
	Tests		Oral exam		(Other)	
	Written exam		Project		(Other)	

Grading and evaluating student work in class and at the final exam			
Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	S. Nižetić, Termodnimika 2, online predavanja (FESB), 2010.		
	F. Bošnjaković: Nauka o toplini (I i II dio), Tehnička knjiga, Zagreb, 1970 i 1976	2	
	O. Fabris: Osnove inženjerske termodinamike, Pomorski fakultet Dubrovnik, Dubrovnik, 1994.	3	

Optional literature (at the time of submission of study programme proposal)	-E. Kulić, A. Lekić, P. Kesić, O. Fabris: Zbirka riješenih zadataka iz termodinamike, Mašinski fakultet, Sarajevo, 1968 -A. Galović, M. Tadić, B. Halasz, "Nauka o toplini II", Zbirka zadataka FSB, 1996.		
Quality assurance methods that ensure the acquisition of exit competences	- Evaluation of results in accordance with the above learning outcomes - Feedback from students via surveys - Self-evaluation of teachers - Institutional and non-institutional evaluations		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	**TECHNOLOGY 1**						
Code	FETC03	Year of study	2.				
Course teacher	PhD Nikša Krnić, Associated professor PhD Sonja Jozić, Assistant professor	Credits (ECTS)	6				
Associate teachers		Type of instruction (number of hours)	L	S	AE	LE	DE
			60			30	
Status of the course	Obligatory	Percentage of application of e-learning					
COURSE DESCRIPTION							
Course objectives	*Part Welding:* - to furnish students with suitable basic knowledge about joining, cutting or other allied processes and to prepare them for challenges of modern production industries in these technological fields and - to enable students thoretical and practical insight into conventional and advanced welding and allied processes, their interactions with metals with accent on structural metals and alloys, metal's weldability and quality of welded structures. *Part Casting:* Training students for: - aquiering knowledge about different methods of casting metal. Understanding of the connection between the chemical composition and structure of the cast, as well the casting parameters with exploitation properties of cast.						
Course enrolment requirements and entry competences required for the course	Passed exams Materials 1 and Materials 2.						
Learning outcomes expected at the level	Upon successful *Welding* course completion it is to be expected from students:						

<table>
<tr><td>of the course (4 to 10 learning outcomes)</td><td colspan="2">1. to make distinction and to recognize basic features of the main joining and thermal cutting processes and their implementation and to distinguish different machines and apparatus for their industrial applications,
2. to select basic welding parameters of electric arc processes and to know the effects they produce on welded metals (carbon steels and aluminium),
3. to analyze welding or cutting process characteristics and to apply that on suitable metal,
4 to correlate energy effects with macro- and microstructure on the example of carbon steels,
5. to be able to distinguish different welding defects and to know methods of mechanical testing of welded joints.

Students will be able to:
7. categorize casting methods
8. bring in relation the chemical composition and structure of the casting, as well the casting parameters with exploitation properties of casting.
9. present methods of making models, cores and moulds for casting.
10. introduce of determining fluidity alloys and the theoretical foundations of casting solidification.</td></tr>
<tr><td rowspan="16">Course content broken down in detail by weekly class schedule (syllabus)</td><td>Course content</td><td>L hours</td></tr>
<tr><td>Part Welding</td><td></td></tr>
<tr><td>Historical overview and principles of the joining and cutting technologies. Basic terminology and classification of the welding processes (fusion and solid state). Forms of energy and basic heat flow in welding. Hazards and safety.</td><td>2</td></tr>
<tr><td>Joint designs and welding positions. Filler metals and consumables. Features and characteristics of electric arc and welding plasma. Main types of power sources for electric-arc welding and their characteristics (CC/drooping and CP/flat).</td><td>4</td></tr>
<tr><td>Classification, features, parameters, interaction with metals, process variations and industrial applications of the electric arc welding processes: shielded metal arc (SMAW), gas metal arc (GMAW ie. MAG/MIG), gas tungsten arc (GTAW ie. TIG), submerged arc (SAW), plasma arc (PAW) and stud welding.</td><td>10</td></tr>
<tr><td>Other fusion welding processes: high power beam processes – laser beam (LBW) and electron beam (EBW) welding, electro-slag welding, thermit welding, oxy-fuel (gas) welding …</td><td>3</td></tr>
<tr><td>Classification, features, parameters, interaction with metals and industrial applications of the solid state welding processes – cold, friction, ultrasonic, resistance, diffusion and explosion welding. Contemporary welding processes – hybrid laser-arc (HLA) and friction stir (FSW) welding.</td><td>4</td></tr>
<tr><td>Mechanization, automation and robotzation of welding
Basics of brazing, soldering, overlay welding, thermal spraying and adhesion joining.</td><td>3</td></tr>
<tr><td>Thermal cutting and gouging. Basic welding metallurgy and weldability of carbon steels and aluminium alloys.</td><td>3</td></tr>
<tr><td>Quality of welded joints. Weld discontinuities, defects and mechanical properties. Non-destructive testing and testing of mechanical properties of welded joints. General information on welding distortions and residual stresses.</td><td>3</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Part Casting</td><td></td></tr>
<tr><td>Introduction, basic terms in the foundry, history of casting technology. Alloys for casting.</td><td>4</td></tr>
<tr><td>Casting patterns, permanent patterns, expendable patterns. Moulds for casting, permanent and expendable moulds, cores.</td><td>4</td></tr>
</table>

	Casting processes: pressure die casting, centrifugal casting, continous casting, sand casting, precise casting.	4
	Tests for fluidity, solidification of metals. Deviations in castings.	4
	Aggregates for melting metals: cupola furnace, the furnace flame, electric ovens. Technology of design, guidelines for the design of castings.	4
	List of exercises	E hours
	Part Welding (laboratory exercises)	
	Health hazards, precautions and safety in welding laboratory. Presentation of basic features, handling and selection of the the basic welding parameters of the main types of the electric-arc welding power sources. Measurement and creation of drooping static voltage – current characteristic of the welding transformer.	3
	Measurement and creation of static voltage – current characteristic of electric arc. Experimental determination of arc stability by covered and bare electrode. Demonstration and practical welding of shielded metal arc welding with different types of covered electrodes.	3
	Experimental characterization of metal transfer in electric arc by different current intensities in shielded metal arc welding. Practical demonstration of mechanized gravitational SMAW and submerged arc welding (SAW).Demonstration and practical welding of mild steel by gas metal arc welding (MAG).	3
	Demonstration and practical welding of aluminium by gas metal arc welding (MIG). Demonstration and practical welding of stainless steel and aluminium by gas tungsten arc welding (TIG). Practical demonstration of spot electro resistance welding and rotational friction welding.	3
	Practical demonstration of oxy-acetylene welding, brazing, soldering and flame spraying. Experimental presentation of oxy-fuel and arc plasma cutting effects on different alloys. Practical demonstration of weld gouging.	3
	Practical presentation of robotic GMA welding.	1
	An adequate educational and professional excursion and visit to one relevant company dealing with joining or allied processes could be organized as an additional but nonmandatory learning opportunity for students.	(x)
	Part Casting (laboratory or design exercises)	
	Permanent and expendable patterns, sand moulds for single use	2
	Metal patterns, metal moulds and sand cores for casting of piston	2
	Analysis of castings made by different casting techniques	2
	Analysis of casting defects.	2
	Determining of mould features; sprue, riser, runner system etc.	2

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☒ multimedia ☒ laboratory ☐ work with mentor ☐ (other)
Student responsibilities	*Part Welding:* Mandatory minimum attendance: 70 % for the lectures and 85 % for lab exercises. Approved reports from every lab excersise. *Part Casting:* The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises.	

Screening student work *(name the proportion of ECTS*	Class attendance	2,5	Research		Practical training	
	Experimental work	0,5	Report		Individual work	3

<table>
<tr><td rowspan="3">credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">Part Welding
In order to take the exam students are obliged to regulary attend lectures (> 70 %) and lab excercises and to prepare written reports from every lab excercise. There are two written midterm or partial exams in regular and officially announced terms during the semester (one at the middle and the other at the end of the semester). Midterm exams encompasse approximately one half of welding course topics. Students who successfully complete both midterm exams (more than 50 %) are administered to and have to satisfy a short oral examination.
Unsuccessful termination of one or both partial exams qualifies students for final written in regular summer or fall exam terms and oral check. Grade is formed upon the success on midterm partial written exams or on final written exam and upon success on short oral examination. For 50 % to 61 % successfully and satisfactorly adopted knowledge grade (2) or sufficient is earned for 62 % to 74 % grade (3) or good, for 75 % to 87 % grade (4) or very good and over 88 % grade (5) or excellent is administered. Regularity of student's attendance of lectures and exercises and quality of laboratory exercises reports can improve the final grade.

Part Casting
There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. In the final exams students that did not pass the midterm exams take part. In the makeup exam students take the entire exam. The midterm, final and makeup exams are carried out as written tests. The requirements for passing grade is:
1. Positive assessment of laboratory exercises
2. 50 % points on each midterm exam or the final exam.
Grade (in percentage) is formed according to the formula:
Grade(%) = 0,5 (M1 + M2)
M1, M2 – test results of first and second midterm exam.
Final grade is determined according to:
Percentage Grade
50% to 61% sufficient (2)
62% to 74% good (3)
75% to 87% very good (4)
88% to 100% excellent (5).

Final grade is calculated as an arithmetical mean of the grades earned for parts Welding and Casting.</td></tr>
<tr><td rowspan="2">Required literature (available in the library and via other media)</td><td colspan="3">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="3">Anzulović, B.: Zavarivanje, FESB Split 1990.
Lukačević, Z.: Zavarivanje, SF Slavonski Brod 1997.
S. Kralj i Š. Andrić: Zavarivanje i srodni postupci, FSB Zagreb 1999.
Gojić, M.: Tehnike spajanja i razdvajanja materijala, MF Sisak, 2008.
Krnić, N.: Handouts, unpublished, - 2016.</td><td></td><td></td></tr>
<tr><td colspan="3"></td><td></td><td></td></tr>
</table>

	Jozić, S., Predavanja objavljena na eLearning portal, FESB, Split, 2016.		eLearning portal
	Živković, D., "Lijevanje metala", skripta, Sveučilište u Splitu, FESB, Split, 2006.		
	Unkić, D., Glavaš, Z.,"Osnove lijevanja metala", skripta, Sveučilište u Zagrebu, Metalurški fakultet, Sisak, 2009.		
Optional literature (at the time of submission of study programme proposal)	Various books, handbooks, conference proceedings, manuals, journals, manufacturer informations and relevant and distinguished web documents in Croatian and English: Welding Handbook, Vol. 1 - 4, Welding Technology, Welding Processes, Materials and Applications, American Welding Society, 1992 Zavarivanje, Welding Journal, Schweissen und Schneiden, Kalpakjian, S., Schmid S.R., "Manufacturing Engineering & Technology", Prentice Hall, 2013.		
Quality assurance methods that ensure the acquisition of exit competences	- Evaluation of results in accordance with the above learning outcomes - Feedback from students via surveys - Self-evaluation of teachers - Institutional and non-institutional evaluations		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	**TECHNOLOGY 2**						
Code	FETC04	Year of study	3				
Course teacher	Dražen Bajić, Ph.D.,Full Professor Branimir Lela, Ph. D., Assistant Professor	Credits (ECTS)	6				
Associate teachers	Sonja Jozić, Ph. D., Assistant Professor Jure Krolo, Teaching assistant, Mario Veić, Teaching assistant	Type of instruction (number of hours)	L	S	AE	LE	DE
			60	0	0	0	30
Status of the course	Obligatory	Percentage of application of e-learning	10%				
COURSE DESCRIPTION							
Course objectives	Training students for: - acquisition of basic knowledge of manufacturing processes by means of metal forming processes and metal removal processes, - understanding basic features of various processes that are based on shaping of the product without and with chip removals.						
Course enrolment requirements and entry competences required for the course	None.						

<table>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="3">Students will be able to:

- categorize metal forming processes and metal removal processes
- design the use of machining and metal forming technologies
- outline procedures and machines used in metal forming processing
- comment flow stress and flow rules
- derive expressions to calculate forces, stresses, strains and strain rates in metal forming processes
- analyse the flow of materials, friction factor, flow stress, work and power in metal forming processes
- derive expressions to calculate the cutting speed, material removal volume, cutting force, torque, power, theoretical roughness and the main machine time for particular machining operations
- analyse the mechanics of orthogonal and oblique cutting
- analyse the mechanisms and forms of tool wear in machining
- classify sources of vibration during machining</td></tr>
<tr><td rowspan="28">Course content broken down in detail by weekly class schedule (syllabus)</td><td>Course content</td><td>L hours</td><td>AE hours</td></tr>
<tr><td>Introduction. Classification of metal-removal processes. Basic features particular machining procedures.</td><td>4</td><td>/</td></tr>
<tr><td>Parameters of cutting. Basic principles, tool and workpiece motion.</td><td>4</td><td>/</td></tr>
<tr><td>Basic tool geometry. Models of chip formation, shape and size of chip. Chips compression, compression rate. Conditions of occurrence of build up edge.</td><td>4</td><td>/</td></tr>
<tr><td>Cutting forces, power, vibrations during machining. Thermal phenomena in cutting.</td><td>4</td><td>/</td></tr>
<tr><td>Tribology of machining process</td><td>4</td><td>/</td></tr>
<tr><td>Integrity of machined surface.</td><td>4</td><td>/</td></tr>
<tr><td>Cutting-tool materials. High speed machining.</td><td>4</td><td>/</td></tr>
<tr><td>First midterm exam</td><td></td><td></td></tr>
<tr><td>Introduction; Classification of deformation processes; Concept of plastic deformation;</td><td>4</td><td>/</td></tr>
<tr><td>Material plasticity indicators; Changes in material caused by deformation; Anisotropy;</td><td>4</td><td>/</td></tr>
<tr><td>Deformation strain and strain rate; Flow stress and flow curves; Yield criteria;</td><td>4</td><td>/</td></tr>
<tr><td>Upsetting processes; Forging processes; Drawing processes</td><td>4</td><td>/</td></tr>
<tr><td>Extrusion processes; Rolling processes;</td><td>4</td><td>/</td></tr>
<tr><td>Sheet metal bending; Deep drawing and spinning processes; Stamping processes;</td><td>4</td><td>/</td></tr>
<tr><td>Second midterm exam</td><td></td><td></td></tr>
<tr><td>List of laboratory exercises</td><td colspan="2">LE hours</td></tr>
<tr><td>Turning, Tool and workpiece geometry, Chip shapes, Cutting-tools materials, 1st part</td><td colspan="2">2</td></tr>
<tr><td>Turning, Tool and workpiece geometry, Chip shapes, Cutting-tools materials, 2nd part</td><td colspan="2">2</td></tr>
<tr><td>Planing and slotting, compression rate measurement</td><td colspan="2">2</td></tr>
<tr><td>Drilling, sinking, and reaming. Measuring the axial force and torque for drilling</td><td colspan="2">2</td></tr>
<tr><td>Sawing, broaching. Measuring the main cutting force for turning using the power consumption.</td><td colspan="2">2</td></tr>
<tr><td>Milling. Measuring the surface roughness in relation with cutting parametars.</td><td colspan="2">2</td></tr>
<tr><td>Grinding, honing, superfinishing. Measuring the cutting forces using three component dynamometer</td><td colspan="2">2</td></tr>
</table>

	Deformation influence on material mechanical properties	2
	Investigation of material flow	2
	Friction coefficient determination by ring and cylinder upsetting	2
	Flow stress determination by strip and cylinder upsetting	2
	Testing of material formability by upsetting and forging	2
	Testing of material formability by extrusion; Determination of sheet metal spring-back during bending	2

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☒ multimedia ☒ laboratory ☐ work with mentor ☐ (other)
Student responsibilities	The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises.	

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	2,5	Research		Practical training	
	Experimental work	0,5	Report		Individual work	3
	Essay		Seminar essay		(Other)	
	Tests		Oral exam		(Other)	
	Written exam		Project		(Other)	

Grading and evaluating student work in class and at the final exam

There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. In the final exams students that did not pass the midterm exams take part. In the makeup exam students take the entire exam. The midterm, final and makeup exams are carried out as written tests. The requirements for passing grade is:

3. Positive assessment of laboratory exercises
4. 50 % points on each midterm exam or the final exam.

Grade (in percentage) is formed according to the formula:

Grade(%) = 0,5 (M1 + M2)

M1, M2 – test results of first and second midterm exam.

Final grade is determined according to:

Percentage	Grade
50% do 61%	sufficient (2)
62% do 74%	good (3)
75% do 87%	very good (4)
88% do 100%	excellent (5)

Examination terms: according to the timetable

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Duplančić, I.: “Obrada deformiranjem”, Sveučilište u Splitu, FESB, Split 2007.	5	
	Bajić, D. “Obrada odvajanjem”, autorizirana predavanja.		e-learning portal
	Ekinović S.: “Postupci obrade rezanjem”, Univerzitet u Sarajevu, Mašinski fakultet u Zenici, 2003.		

Optional literature (at the time of submission of study	- Povrzanović, A. “Obrada metala deformiranjem – odabrana poglavlja”, Sveučilište u Zagrebu, Fakultet strojarstva i brodogradnje, Zagreb, 1996.

programme proposal)	- Math M., "Uvod u tehnologiju oblikovanja deformiranjem", Sveučilište u Zagrebu, Fakultet strojarstva i brodogradnje, Zagreb, 1999. - Lange K.: "Lehrbuch der Umformtechnik I, II, III", Springer - Verlag Berlin, Heidelberg, New York, 1974. - Kalpakjian, S., Schmid S.R., "Manufacturing Engineering & Technology", Prentice Hall, 2013. - Grote, K.H., Antonsson, G., "Handbook of Mechanical Engineering", Springer, 2008.
Quality assurance methods that ensure the acquisition of exit competences	- Keeping records of class attendance - Evaluation of results in accordance with the above learning outcomes - Feedback from students via surveys - Self-evaluation of teachers - Feedback information from graduated students
Other (as the proposer wishes to add)	

NAME OF THE COURSE	**THERMAL MACHINES**						
Code	FESC14	Year of study	3.				
Course teacher	Gojmir Radica, Ph. D., Full Professor	Credits (ECTS)	6				
Associate teachers	Dario Bezmalinović, Ph. D., Teaching assistant Ivan Tolj, Ph. D., Teaching assistant Tino Sumić, Teaching assistant	Type of instruction (number of hours)	L	S	AE	LE	DE
			45	0	15	15	0
Status of the course	Obligatory	Percentage of application of e-learning	0				
COURSE DESCRIPTION							
Course objectives	Training students for: - understanding of basic principles of internal combustion engines and compressors, - setting up and solving thermodynamic and design parameters of IC engines, - permanent adoption and deepening of knowledge in the field of IC engines.						
Course enrolment requirements and entry competences required for the course	Thermodynamics, Fluid Mechanics						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - identify different types of thermal machines, - calculate basic design and performance parameters of internal combustion engines and compressors,						

	- analyze the energy transformation in thermal machines and its dependence on basic working and dimensional characteristics of the process, - select a heat engine for the particular system based on its energy characteristics, - evaluate proper use of materials, fuel type, scavenging process and combustion quality, - analyze exhaust gas emissions and reduction methods, - estimate the state of the thermal machine.		
Course content broken down in detail by weekly class schedule (syllabus)	Course content	L or S hours	AE hours
	Introduction to thermal machines. Brief history of thermal machines. Internal combustion engines definition. Description of system and engine parts.	3	1
	Design and operating parameters. Brake power and torque. Indicated work. Mechanical efficiency.	3	1
	Mean effective pressure. Specific fuel consumption. Air excess ratio. Volumetric efficiency. Emissions. Power. Torque..	3	1
	IC Engine working cycles. Otto cycle. Diesel cycle. Sabathė cycle. Two stroke. Four stroke.	3	1
	Inlet and exhaust systems. Diesel fuel systems. Direct and indirect injection systems. Fuel characteristics.	3	1
	Otto engines - fuel systems.	3	1
	Gas engines.	3	1
	Scavenging. Turbocharging. Turbocharger design and characteristics.	3	1
	Classification and application of compressors. Thermodynamic fundamentals of single- and multi-stage compressor operation. Compressor power consumption.	3	1
	Reciprocating compressors, design and constructive features. Calculation and design of single- and multi-stage reciprocating compressors. Dynamics of a reciprocating mechanism.	3	1
	Suction and discharge valves of reciprocating compressors. Ideal and actual capacity. Capacity control. Efficiency.	3	1
	Screw compressors, constructive features, capacities and control. Scroll compressors, constructive features capacities and control. Vane compressors.	3	1
	Turbo compressors, constructive features, performance and control..	3	1
	List of laboratory or design exercises		LE or DE hours
	Engine parts, technical specification.		2
	Engine constructive and operating parameters. Testing.		3
	Brake power and torque. Indicated work. Efficiency. Fuel consumption. Maintenance and diagnostic.		3
	Emission measuring and analysing		3
	Compressor parts, technical specification, characteristics.		2

Format of instruction	☒ lectures ☐ seminars and workshops ☒ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☒ multimedia ☒ laboratory ☐ work with mentor ☐ (other)
Student responsibilities		

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*						
	Class attendance	2,5	Research		Practical training	
	Experimental work		Report		(Other)	3,2
	Essay		Seminar essay		(Other)	
	Tests	0,2	Oral exam		(Other)	
	Written exam	0,1	Project		(Other)	

Grading and evaluating student work in class and at the final exam	There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. In the final exams students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests (oral test-if necessary). The requirement for passing grade is the positive assessment of exercises and 50 % points for theory and exam on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula: Grade(%) = 0,54 (M1 + M2) the activities in percentage: • M1, M2 – test results.

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	Radica G.: Predavanja iz predmeta Toplinski strojevi		e-learning portal
	Grljušić M.:" Motori s unutrašnjim izgaranjem", Sveučilište u Splitu, FESB, 2000	5	
	Fabris O., Grljušić M.:" Kompresori", Sveučilište u Splitu, FESB, 2009.	5	

Optional literature (at the time of submission of study programme proposal)	1.Stone R.:" Introduction to Internal Combustion Engines", University of Oxford, PALGRAVE, N.Y., 1999. 2.Jeras D.:" Klipni motori-uređaji", Školska knjiga, Zagreb, 1992. 3.Andrassy M.:" Kompresori", FSB, Sveučilište u Zagrebu, 2001. 4 J.H. Horlock, D.E Winterbone The Thermodynamics and gas dynamic of internal-combustion engines, , Oxford, 1986. 5. J. B. Heywood: Internal combustion engines fundamentals, McGraw-Hill, 1988
Quality assurance methods that ensure the acquisition of exit competences	– Evaluation of results in accordance with the above learning outcomes – Feedback from students via surveys – Self-evaluation of teachers

	– Institutional and non-institutional evaluations
Other (as the proposer wishes to add)	

NAME OF THE COURSE	**ELECTRICAL ENGINEERING AND ELECTRONICS**						
Code	FENC01	Year of study	3.				
Course teacher	Ivan Marinović, Ph.D., Full Professor Ivica Jurić-Grgić, Ph.D., Associate Professor	Credits (ECTS)	4				
Associate teachers	Duje Čoko,Ph.D,, Teaching assistant Nedjeljka Grulović–Plavljanić, Teaching assistant Ivan Krolo, Teaching assistant	Type of instruction (number of hours)	L	S	AE	LE	DE
			30	0	15	15	0
Status of the course	Obligatory	Percentage of application of e-learning	0				
COURSE DESCRIPTION							
Course objectives	Training students for: - application of basic principles and laws of electrical engineering, - setting up and solving simple electrical circuits, - permanent adoption of basic knowledge in the field of electrical machines, - thorough understanding of physical principles within semiconductors - basic digital and analog circuit analysis - application of Boolean algebra - understanding the basic functions of microcontroller systems						
Course enrolment requirements and entry competences required for the course	None						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - definethe fundamental phenomena, the quantities and the laws of electrical engineering, - apply fundamental laws of electrical engineering for the calculation of electromagnetic quantities, - analyse simple electrical networks, - measure basic electrical values (current, voltage, resistance). - describe basic principles of electrical machines. - recognize basic analog and digital electronic circuits - DC and AC analysis of basic circuits incorporating diodes and transistors - solve Boolean algebra problems - understand the basic microcontroller system functions						

<table>
<tr><td rowspan="20">Course content broken down in detail by weekly class schedule (syllabus)</td><td>Course content</td><td>L hours</td><td>AE hours</td></tr>
<tr><td>Electrostatics:electricity and physical property of matter;Coulomb's law;electric field; electric flux density, electrical work, electrostatic voltage,electrostatic potential, capacitance, capacitors, static electricity.</td><td>2</td><td>2</td></tr>
<tr><td>DC currents: Electric circuits; electrical property of matter; Electrical conductivity and electrical resistance; voltage and current sources;Ohm's law; temperature dependence of electrical resistance; series, parallel and combination circuits; Kirchhoff's Laws; power and energy of DC current; circuit analysis techniques; electrolysis and chemical sources of electric current.</td><td>2</td><td>2</td></tr>
<tr><td>Magnetism:Basics of magnetism; natural magnet and electromagnet; magnetic flux; Faraday's law; magnetic forces on moving charges and on a current-carrying wire; magnetic force between two parallel current-carrying wires; Ampere's Law; toroidal solenoid. Mutual and self inductance; leakage of magnetic flux; ferromagnetism; magnetic hysteresis; magnetic circuit; magnetic energy;magnetic force.</td><td>2</td><td>1</td></tr>
<tr><td>AC currents: Current and voltage sinusoidal waveform;form and crest factor; generation of a voltage sinusoidal waveform;Euler's formula for complex numbers;phase relationships in AC Circuits; Ohm's law in complex form;resistive and reactive impedance in AC Circuits; series, parallel and combination AC circuits; circuit analysis techniques using complex numbers; power and energy of AC current;three-phase AC circuits.</td><td>2</td><td>2</td></tr>
<tr><td>Transformers and synchronous machines</td><td>2</td><td>0</td></tr>
<tr><td>Induction motors</td><td>2</td><td>0</td></tr>
<tr><td>DC motors; universal motors.</td><td>2</td><td>0</td></tr>
<tr><td>Semiconductors: diodes, transistors, thyristors</td><td>2</td><td>2</td></tr>
<tr><td>Analog electronic circuits</td><td>2</td><td>2</td></tr>
<tr><td>Digital electronic circuits</td><td>2</td><td>2</td></tr>
<tr><td>Microprocessors</td><td>2</td><td>0</td></tr>
<tr><td>Sensors and actuators</td><td>2</td><td>0</td></tr>
<tr><td>Microprocessor-assisted control of processes and machines</td><td>2</td><td>0</td></tr>
<tr><td>List of laboratory exercises</td><td></td><td>LE hours</td></tr>
<tr><td>Series, parallel and combination DC circuits</td><td></td><td>2</td></tr>
<tr><td>Resistive and reactive impedance in AC Circuits</td><td></td><td>2</td></tr>
<tr><td>Power of AC current</td><td></td><td>2</td></tr>
<tr><td>Open circuit test on transformer</td><td></td><td>2</td></tr>
<tr><td>Basic diode circuits</td><td></td><td>2</td></tr>
<tr><td>Basic transistor amplifiers</td><td></td><td>2</td></tr>
<tr><td>Operational amplifier</td><td></td><td>2</td></tr>
<tr><td>Logic gates, multiplexer, demultiplexer</td><td></td><td>1</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐on line in entirety
☐ partial e-learning
☐ field work
☐ independent assignments
☒ multimedia
☒ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Studentresponsibilities</td><td colspan="3">The presence on lectures in the amount of at least 70% of the times scheduled. Performed all required laboratory exercises.</td></tr>
</table>

Screening student work *(name the proportion of ECTS credits for eachactivity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	1	Research		Practical training	
	Experimental work		Report		Individual work	2
	Essay		Seminar essay		Laboratory exercises	0,5
	Tests	0,2	Oral exam		Preparation for laboratory exercises	0,2
	Written exam	0,1	Project		(Other)	

Grading and evaluating student work in class and at the final exam

During the semester there will be two midterm tests. The first test will be at the eighth week of classes, the second at the first week of the exam period. Student can pass the entire exam by midterm tests.
At the two final exams, students take parts of the curriculum that did not pass by midterm tests. If at the first final exam student passes one of the two parts of curriculum that part of curriculum the student does not have to take on another final exam.

Students who did not pass the exam after two final exams can pass the exam at the last week of August or the first week of September. Last chance to take the exam in this school year is a so-called commission exam. So-called commission exam consist of two separated tests. First test dealing with electrical engineering consist 10 theoretical questions and 2 numerical problems while second one dealing with electronics consists of 6 theoretical questions and 2 numerical problems.

The condition for positive assessment is that the student has at least 50% of each part of the curriculum at the midterm tests or at the final exams. The final grade (in percent) is formed on the basis of all activities according to the formula:

Rating (%) = 0.1 * LV + 0.45 * (G1 + G2)

wherein the activity is expressed in percentage according to:

LV - percentage obtained by laboratory exercises,
G1, G2 - percentage obtained by midterm tests or final exams of the parts of curriculum given in lectures.

The final grade is determined as follows:

Rating	Grade
50% to 61%	sufficient (2)
62% to 74%	good (3)
75% to 87%	very good (4)
88% 100%	excellent (5)

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	I. Jurić-Grgić: Lectures, FESB		e-learning portal
	I. Marinović: Lectures, FESB		e-learning portal

Optional literature (at the time of submission of study	A. Maletić: Osnove elektrotehnike, ELMAP, Split, 1993. R. Wolf: Osnove električnih strojeva, Školska knjiga, Zagreb, 1985. J. Grilec, D. Zorc: Osnove elektronike, Školska knjiga, Zagreb, 2002.

programme proposal)	
Quality assurance methods that ensure the acquisition of exit competences	– Evaluation of students presence on lectures – Evaluation of results in accordance with the above learning outcomes – Feedback from students via surveys – Self-evaluation of teachers – Institutional and non-institutional evaluations
Other (as the proposer wishes to add)	

NAME OF THE COURSE	**THEORY AND TECHNIQUE OF MEASUREMENT**						
Code	FETC13	Year of study	3.				
Course teacher	Ph.D. Boženko Bilić, senior full professor	Credits (ECTS)	5				
Associate teachers	M.sc. Jakša Galić Ph.D. Nikola Gjeldum, assistant professor	Type of instruction (number of hours)	L	S	AE	LE	DE
			45	0	0	15	0
Status of the course	Obligatory	Percentage of application of e-learning	0				
COURSE DESCRIPTION							
Course objectives	Training students for: - Understanding the basic principles of the metrology theory and technique - Acquiring specific skills in methods and techniques of metrology and control.						
Course enrolment requirements and entry competences required for the course	None						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - Interpret metrological terms - Classify measurement errors - Perform measurements in the field of industrial metrology - Assess the measurement uncertainty of the measurement results - Use statistical tools and methods in the analysis, comparison and validation of measurement results - Assess the results of measurements on the basis of critical thinking and intellectual honesty.						
Course content broken down in detail by weekly class schedule (syllabus)	Course content						L hours
	Theory of measurement: Introduction in metrology. Basic terms in metrology: measurement, measurement accuracy, repeatability of results of measurements, reproducibility of results of measurements, traceability of a measurement result, measurement standards, calibration … Physical quantities and measurement units. Measurement errors. Measurement methods.						3
	Theory of measurement: Direct measurement of physical quantities: Statistical analysis of measurement results. Gaussian distribution of						4

	random measurement errors. Experimental standard deviation of the mean.	
	Theory of measurement: Indirect measurement of physical quantities: Standard deviation of indirectly measured physical quantity. Experimental standard deviation of the mean of indirectly measured physical quantity. Systematic error of indirectly measured physical quantity.	3
	Theory of measurement: Measurement uncertainty. Expression of measurement result	3
	Theory of measurement: Basic characteristics of measurement instruments and measurement systems. Capability of measuring system. Measurement transducers.	3
	Measurement technique: Measuring instruments for measuring lengths, forms and positions.	3
	Measurement technique: Methods for measuring dimensions and forms. Systematic errors in the measurement of dimensions and forms.	2
	First midterm exam.	
	Measurement technique: Measurement and control of angles, threads and gears.	6
	Measurement technique: Measurement and control of surface roughness.	2
	Measurement technique: Measurement the forms and positions	3
	Measurement technique: Coordinate measuring machines.	1
	Measurement technique: Temperature measurement: Temperature scales. Thermometers based on thermal expansion. Pressure thermometers. Resistance thermometers. Thermocouples. Quartz thermometer. Radiation thermometers.	3
	Measurement technique: Pressure measurement: Pressure scales. McLeod Gauge. Manometer. Barometer. Pressure transducers.	3
	Second midterm exam.	
	List of laboratory exercises	LE hours
	Introduction with measuring instruments intended for the measurement of dimensions, forms and positions. Certification the dial indicator according to standard DIN 878 Indirect measurement of the distance between the hole centers using a special vernier caliper Measurement an inside diameter using three-point inside micrometer	2
	Comparative measurement of an internal diameter using bore gauge Measurement angle prism using gauge blocks, rollers and dial indicator Measurement angle of prism using the protractor (direct contact measurement)	2
	Measurement the cone angle using sine bar The measurement of the internal angle of the cone Measurement the pitch diameter of thread using screw thread micrometer	2
	Dividing head: indirect indexing and differential indexing Three-wire method of measuring pitch diameter	2
	Direct method for tooth thickness measurement by means of a gear tooth caliper Direct method for tooth thickness measurement by means of a disc-type micrometer (measurement over a several teeth) Runout measurement on gear	2
	Measurement of flatness Runout measurement on shaft Surface roughness measurement	2
	Planning of the measurement process (measurement plan)	2
	Laboratory exercises reports control	1

<table>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☐ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☒ multimedia
☒ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="6">The presence on lectures and exercises in the amount of at least 70 % of the times scheduled. Perform all laboratory exercises.</td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1,5</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Individual work</td><td>3</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>Laboratory exercises</td><td>0,5</td></tr>
<tr><td>Tests</td><td>0</td><td>Oral exam</td><td></td><td>Preparation for laboratory exercises</td><td>0</td></tr>
<tr><td>Written exam</td><td>0</td><td>Project</td><td>1</td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="6">During semester there are two midterm exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. The student can take the first midterm exam if he/she regularly attended classes. Requirements for access to the second midterm exam are: regularly attended classes and at least 25% of points achieved at the first midterm.
Midterm exams are conducted in written form. They consist of theoretical questions and numerical problems. The teacher reserves the right to hold a midterm exam in oral form. The requirement for passing grade represents minimal 50% points on each midterm exam:
Grade (%) = 0,5(M1 + M2)
M1 – first midterm grade (%), i.e. percentage points achieved on the first midterm
M2 – second midterm grade (%), i.e. percentage points achieved on the second midterm
Requirement for access to the final exams is regularly attended classes. In the first two final exams students that did not pass at least one of the midterm exams take part. In the third and fourth final exams students take the whole exam regardless results of midterm exams. Final exams are conducted in written form. They consist of theoretical questions and numerical problems. The teacher reserves the right to hold a final exams in oral form. The requirement for passing grade is positive assessment in exam. Positive assessment represents minimal 50% points on final exam.

Grade (%): Final mark:
50% - 60% sufficient (2)
61% - 75% good (3)
76% - 90% very good (4)
91% - 100% excellent (5)

Grade (%) is average points achieved on midterm exams expressed as a percentage or number of points achieved on the final exam expressed as a percentage.</td></tr>
<tr><td rowspan="3">Required literature (available in the library and via other media)</td><td colspan="3">Title</td><td>Number of copies in the library</td><td>Availability via other media</td></tr>
<tr><td colspan="3">Bilić, B.: Teorija i tehnika mjerenja, FESB, Split, 2007.</td><td>5</td><td></td></tr>
<tr><td colspan="3">Figliola, R. S., Beasley, D. E.: Theory and Design for Mechanical Measurements, John Wiley & Sons, 2011.</td><td>0</td><td></td></tr>
</table>

	Zaimović-Uzunović, N., Lemeš, S., Denjo, D., Softić, A.: *Proizvodna mjerenja*, Mašinski fakultet u Zenici, Zenica, 2009.	0	
	Smith, G. T.: *Industrial Metrology: Surfaces and Roundness*, Springer, 2002.	0	
Optional literature (at the time of submission of study programme proposal)	- Bilić, B.: Predavanja postavljena na e-learning portal - Farago, F. T., Curtis, M. A.: *Handbook of Dimensional Measurement*, Industrial Press Inc, New York, 1994. - Bucher, Jay L.: *The Metrology Handbook*, ASQ Quality Press, 2012. - Bašić, H.: *Mjerenja u mašinstvu*, Mašinski fakultet, Sarajevo, 2008.		
Quality assurance methods that ensure the acquisition of exit competences	– Keeping records of the attendance of students – Annual evaluation of results in accordance with the above learning outcomes – Feedback from students via surveys – Self-evaluation of teachers		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	**DESIGN OF INDUSTRIAL PRODUCTS**						
Code	FESC18	Year of study	3				
Course teacher	Željko Domazet, Ph. D., Full Professor, Lovre Krstulović-Opara, Ph. D., Full Professor	Credits (ECTS)	4				
Associate teachers		Type of instruction (number of hours)	L	S	AE	LE	DE
			30	0	0	0	30
Status of the course	Obligatory	Percentage of application of e-learning	40%				
COURSE DESCRIPTION							
Course objectives	Training students for: - Acquiring basic terminology and methodologies of product design and development with goal to optimise applicability, shape and appearance of industrial products. - Acquiring knowledge about fundaments, methods and technologies for designing industrial products. The course covers product development process from market and concept researches to the product ramp up. - Using CAD program SolidWorks and 3D scanner to create prototypes.						
Course enrolment requirements and entry competences required for the course	None						
Learning outcomes expected at the level of the course (4 to	Students will be able to: - Name main epochs of industrial design. - Name main designers and design schools. - Explain basic of ergonomics, aesthetics and gestalt theory.						

10 learning outcomes)	- Explain generalised product development process. - Describe advanced methods of rapid prototyping and 3D scanning - Design and create simple industrial product by using SolidWorks package.					
Course content broken down in detail by weekly class schedule (syllabus)	Course content				L or S hours	AE hours
	Introduction to DIP and generalized product developement.				2	
	Product planning.				2	
	Identifying customer needs.				2	
	Product specifications.				2	
	Concept generation and selection.				2	
	Product Architecture.				2	
	Industrial design.				2	
	Design for manufacturing.				2	
	Prototyping.				2	
	History of industrial design				2	
	Aesthetics.				2	
	Ergonomy.				2	
	Gestalt theory.				2	
	List of laboratory or design exercises					DE hours
	CAD modelling in software package SolidWorks					6
	3D scanning					1
	Product development from the market research to the CAD prototype.					13
	Preparing final report and product presentation.					8
Format of instruction	☒ lectures ☒ seminars and workshops ☐ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work			☐ independent assignments ☒ multimedia ☐ laboratory ☐ work with mentor ☒ Group work- product developement		
Student responsibilities						
Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)*	Class attendance	2	Research		Practical training	
	Experimental work		Report		Individual work	1
	Essay		Seminar essay	1	(Other)	
	Tests		Oral exam		(Other)	
	Written exam		Project		(Other)	
Grading and evaluating student work in class and at the final exam	Evaluation of gained knowledge in form of two colloquiums. Maximal score is 100 points, while minimum is passing of exam is with 50 points. Exam: individual, theoretical. Mode of exam: written form.					
Required literature (available in the library and via other media)	**Title**				**Number of copies in the library**	**Availability via other media**
	Design of industrial products (in Croatian)					E-learning
	Additional course materials					E-learning

Optional literature (at the time of submission of study programme proposal)	Otto, K. N., Wood K. L., Product Design, Prentice Hall, New York, 2001. Quarante D. Osnove industrijskog dizajna, Sveučilišna naklada Zagreb, 1991.
Quality assurance methods that ensure the acquisition of exit competences	- Student evaluations - Registering student's attendance to course
Other (as the proposer wishes to add)	

NAME OF THE COURSE	**NOISE AND VIBRATION CONTROL**						
Code	FESC26	Year of study	3				
Course teacher	Željan Lozina, Ph.D., Full Professor Damir Sedlar, Ph.D., Assistant Professor	Credits (ECTS)	5				
Associate teachers	Tomac Ivan, Ph.D., Assistant Professor	Type of instruction (number of hours)	L	S	AE	LE	DE
			30		15	15	
Status of the course	Elective	Percentage of application of e-learning	0				
COURSE DESCRIPTION							
Course objectives	Training students for: – introduce students to the requirements, principles and methods of noise and vibration control; – provide basic knowledge and understanding of noise and vibration control; – provide the application of this knowledge to simple problems; -						
Course enrolment requirements and entry competences required for the course	None						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - Explain free and forced vibrations, - Determine the natural frequency of the mechanical system with single degree of freedom, - Explain the concepts and phenomena: transferability, excitation imbalance, vibration isolation, - Explain the principles of noise isolation, - Apply the basic techniques of vibration isolation, - Handle with manual measuring instruments and operate with sensors to measure acceleration (accelerometer).						

<table>
<tr><td rowspan="20">Course content broken down in detail by weekly class schedule (syllabus)</td><td>Course content</td><td>L or S hours</td><td>AE hours</td></tr>
<tr><td>Single degree of freedom system – free undamped vibration</td><td>2</td><td>1</td></tr>
<tr><td>Single degree of freedom system – forced undamped vibration</td><td>2</td><td>1</td></tr>
<tr><td>Single degree of freedom system – free damped vibration</td><td>2</td><td>1</td></tr>
<tr><td>Single degree of freedom system – forced damped vibration</td><td>2</td><td>1</td></tr>
<tr><td>Transmissibility</td><td>2</td><td>1</td></tr>
<tr><td>Base and imbalance excitation, vibration isolation</td><td>2</td><td>1</td></tr>
<tr><td>Two degree of freedom system</td><td>2</td><td>1</td></tr>
<tr><td>Wave equation</td><td>2</td><td>1</td></tr>
<tr><td>Fundamentals of noise</td><td>2</td><td>1</td></tr>
<tr><td>Humane response to sound</td><td>2</td><td>1</td></tr>
<tr><td>Sound source, outdoor sound</td><td>2</td><td>1</td></tr>
<tr><td>Indoor sound</td><td>2</td><td>1</td></tr>
<tr><td>Sound isolation</td><td>2</td><td>1</td></tr>
<tr><td>List of laboratory or design exercises</td><td colspan="2">LE or DE hours</td></tr>
<tr><td>Introduction to Labview</td><td colspan="2">2</td></tr>
<tr><td>Single degree of freedom system – free damped vibration</td><td colspan="2">1</td></tr>
<tr><td>Frequency response function SDOF – shaker</td><td colspan="2">1</td></tr>
<tr><td>Frequency response function SDOF – unbalance</td><td colspan="2">1</td></tr>
<tr><td>Single plane balancing</td><td colspan="2">1</td></tr>
<tr><td>Frequency response function MDOF – shaker</td><td colspan="2">2</td></tr>
<tr><td>Sound pressure measurement - Labview</td><td colspan="2">1</td></tr>
<tr><td>Sound pressure measurement – Hand tool</td><td colspan="2">1</td></tr>
<tr><td>Sound isolation</td><td colspan="2">1</td></tr>
<tr><td>Reverberation time</td><td colspan="2">1</td></tr>
<tr><td>Kundt tube</td><td colspan="2">1</td></tr>
<tr><td>Format of instruction</td><td colspan="3">☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work
☐ independent assignments
☐ multimedia
☒ laboratory
☐ work with mentor
☐ (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="3">The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises.</td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td colspan="6">
<table>
<tr><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical training</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>Individual work</td><td>3</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td>(Other)</td><td></td></tr>
</table>
</td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="3">There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. In the final exams students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests. The requirement for passing grade is 50 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula:
Grade(%) = 0,5 (M1 + M2)
• M1, M2 – test results.</td></tr>
</table>

	Title	Number of copies in the library	Availability via other media
Required literature (available in the library and via other media)	Ž. Lozina: Lectures, FESB D. Sedlar: Lectures, FESB		Elearning portal
	B.H. Tongue: Principles of vibration, Oxford University press, 1996		
Optional literature (at the time of submission of study programme proposal)	M. Norton, D. Karczub: Fundamentals of Noise and Vibration Analysis for Engineers, Cambridge, 2003.		
Quality assurance methods that ensure the acquisition of exit competences	- Evaluation of results in accordance with the above learning outcomes - Feedback from students via surveys - Self-evaluation of teachers - Institutional and non-institutional evaluations		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	**Race Vehicle Project**						
Code	FESC27	Year of study	Year 3, Semester 6				
Course teacher	PhD. Ivo Marinić-Kragić	Credits (ECTS)	4				
Associate teachers		Type of instruction (number of hours)	L	S	AE	LE	DE
			15	15			30
Status of the course	Elective	Percentage of application of e-learning					
COURSE DESCRIPTION							
Course objectives	Develop engineering skills through work on Formula Student project.						
Course enrolment requirements and entry competences required for the course	Mechanics 3 (Dynamics). Computer aided analysis.						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: 11. Plan and organize project for racing vehicle components 12. Participate in teamwork on solving existing engineering problems 13. Present the developed concept (project), independently and as a part of the team 14. Select the best form of communication and presentation technique for the completed assignment and achieved results of the engineering task, considering the level and expectation of the listener						

<table>
<tr><td rowspan="20">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="3">Course content</td><td>L or S hours</td><td>AE hours</td></tr>
<tr><td colspan="3">Introduction to race vehicles and project Formula Student</td><td>2</td><td></td></tr>
<tr><td colspan="3">Racing vehicle as a multi-disciplinary system (objectives, construction requirements, subsystems integration, system simulations)</td><td>2</td><td></td></tr>
<tr><td colspan="3">Racing vehicle dynamics and suspension</td><td>2</td><td></td></tr>
<tr><td colspan="3">Racing vehicle propulsion systems (electric and conventional). Cooling systems.</td><td>2</td><td></td></tr>
<tr><td colspan="3">Racing vehicle structure. Ergonomics.</td><td>2</td><td></td></tr>
<tr><td colspan="3">System control. Measurement and telemetry.</td><td>2</td><td></td></tr>
<tr><td colspan="3">Seminars and project assignments</td><td>12</td><td></td></tr>
<tr><td colspan="3"></td><td></td><td></td></tr>
<tr><td colspan="3"></td><td></td><td></td></tr>
<tr><td colspan="3"></td><td></td><td></td></tr>
<tr><td colspan="3">List of laboratory or design exercises</td><td colspan="2">LE or DE hours</td></tr>
<tr><td colspan="3">Introduction to project Formula Student. Practical demonstrations.</td><td colspan="2">2</td></tr>
<tr><td colspan="3">Introduction to numerical simulations. 1D system simulations.</td><td colspan="2">2</td></tr>
<tr><td colspan="3">Basic dynamical model of racing vehicle.</td><td colspan="2">2</td></tr>
<tr><td colspan="3">Tire model. Aerodynamic models.</td><td colspan="2">2</td></tr>
<tr><td colspan="3">Models for propulsion and transmission.</td><td colspan="2">2</td></tr>
<tr><td colspan="3">Structural analysis.</td><td colspan="2">2</td></tr>
<tr><td colspan="3">Practical introduction to sensors. Design of experiments (testing).</td><td colspan="2">2</td></tr>
<tr><td colspan="3">Seminars and discussions.</td><td colspan="2">12</td></tr>
<tr><td>Format of instruction</td><td colspan="2">☒ lectures
☒ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="3">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☒ project (other)</td></tr>
<tr><td>Student responsibilities</td><td colspan="5"></td></tr>
<tr><td rowspan="5">Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical training</td><td>1</td></tr>
<tr><td>Experimental work</td><td></td><td>Report</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Tests</td><td></td><td>Oral exam</td><td></td><td>(Other)</td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td>2</td><td>(Other)</td><td></td></tr>
<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="5">The learning outcomes are achieved through work on the project assignment which includes the selected components of Formula Student project. Continued assessment of students during lectures, seminars and exercises.
Grading: oral defense of the project assignments (presentation) in presence of teachers and students, with discussion of the proposed project</td></tr>
</table>

	Title	Number of copies in the library	Availability via other media
Required literature (available in the library and via other media)	Depending on project assignment		
Optional literature (at the time of submission of study programme proposal)	Depending on project assignment. Matt Brown, “Racecar: Searching for the Limit in Formula SAE”, 2011., Seven Car Publishing William F. Milliken, Douglas L. Milliken, “Race Car Vehicle Dynamics”, 1994,.SAE International, ISBN of 978-1-56091-526-3		
Quality assurance methods that ensure the acquisition of exit competences	- Through the established quality assurance system of the Faculty - Annual analysis of the performance of the examination - Feedback information regarding the relevance of the course contents from students that completed the postgraduate program		
Other (as the proposer wishes to add)	English or Croatian		