U N I V E R S I T Y O F S P L I T

FACULTY OF ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE

DETAILED PROPOSAL OF THE STUDY PROGRAMME

UNDERGRADUATE UNIVERSITY STUDY IN INDUSTRIAL ENGINEERING

SPLIT, February 2022

1.1. List of mandatory and elective courses

List of courses								
Year of study: 2.								
Semester: III.								
STATUS	CODE	COURSE	HOURS IN SEMESTER					ECTS
			L	S	AE	LE	DE	
	FETE01	Technology 1	45	0	0	30	0	6
	FEEE11	Computer Aided Design 1	30	0	0	0	30	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	
Mandatory	FESE02	Mechanics of Materials	45	0	30	0	0	7
	FETE02	Technology 2	45	0	0	30	0	6
	FESE17	Computer - Aided Analysis	30	0	0	30	0	5
	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	
	FESE05	Thermodynamics	45	0	30	0	0	6
	FESE04	Design of Industrial Products	30	0	0	0	30	5
	FESE06	Introduction to Information Systems	30	0	0	15	0	4
	L = Lectures, S = Seminar, AE = Auditory Exercises, LE = Laboratory Exercises, DE = Design Exercises							

1.2. Course description

NAME OF THE COURSE	TECHNOLOGY 1							
Code	FETE01	Year of study	2					
Course teacher	Nedjeljko Mišina, Ph.d. full professor Dražen Živković, Ph.d. full 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	Training students to: - Understand the physical changes in welding, brazing and soldering, bonding,metallisation and thermal cutting of metal. - Explain of the basic welding processes and their application. - Accept the standards in welding, certification of the welding procedures and welders. - Understand the basic foundry processes, as well as the advanced techniques of casting metal. - recognize the primary smelting aggregates, the newer materials casting process, such as metal foams, - Overview of casting defects		
Course enrolment requirements and entry competences required for the course	Passed exams form: Materials 1 and Materials 2		
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - Select the appropriate welding process, filler material and welding parameters, - Develop welding technology, - Calculate the preheating temperature of the welded joint, - Propose measures to reduce deformations and residual stresses in welded joints, - Recognise the process of metal casting, - Distinguish casting mould type, - Analyse the quality of castings based on foundry defects - Explain the fundamental principles of smelting aggregates		
Course content broken down in detail by weekly class schedule (syllabus)	Course content	L hours	AE hours
	Introduction. Basic terms. Welding processes. The properties of welded joints. Power sources for welding.	3	0
	Deformations and residual stresses of welded joints. Electric arc. Metal transfer in the electric arc.	3	0
	SMAW welding process. TIG welding process. Plasma.	3	0
	MIG / MAG welding process. EPP welding process.	3	0
	Resistance welding. Gas welding. Special welding processes. Welding devices. Robots.	3	0
	Welding defects. Brazing and soldering. Gas and plasma cutting. Oxyarc. Arcair.	3	0
	Certification of the welding procedures and welders. Regulations in welding. Welding technology. Preheating	3	0

	welds. Weldability of: carbon steels, irons, Al and Ti alloys, stainless steels.		
	First midterm exam		
	Introduction to casting technology. Casting models	3	2
	Casting moulds. Disposable moulds - mould materials	3	2
	Mould cores, design, materials, moulds manufacturing control	3	2
	Multiple purposes moulds. Casting procedures - Continuous casting	3	2
	Casting procedures - Centrifugal casting. Precision casting in the disposable moulds. Precision Casting in permanent moulds	3	2
	Castability. Casting technological tests. Basics of the solidification process. Casting defects, Smelting aggregates, Metal foam casting.	3	2
	Second midterm exam		
	List of laboratory or design exercises		LE
	Basic concepts of welding. The division of welding processes.		3
	The impact of coated electrodes on the stability of the electric arc. SMAW welding process. MIG / MAG welding process		3
	EPP welding process. EO welding. Friction welding.		3
	TIG welding process. Gas welding. Brazing and soldering.		3
	Gas and plasma cutting. Oxyarc. Arcair. Metallisation		3
	First midterm exam		
	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. 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!

<table>
<tr><td></td><td colspan="3">The final grade is determined after the second final exam, applying the absolute ECTS grading system in accordance with the study rules and study system of the University of Split. Students who did not pass the exam after two final exams have the last chance to pass exam in the autumn period. Overall material has to be passed at last possible exam.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>N. Mišina: the author's lecture, FESB</td><td></td><td>E-learning</td></tr>
<tr><td>D. Živković, the author's lecture, FESB</td><td></td><td>E-learning</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">- S. Kralj, Š. Andrić: Zavarivanje i srodni postupci, FSB, Zagreb, 1999.
- M. Gojić: Tehnika spajanja i razdvajanja materijala, Metalurški fakultet , Sisak, 2003.
- D.Živković, Lijevanje metala, Interna skripta, 2006.
- Z.Bonačić, I. Budić, Osnove tehnologije kalupljenja – Jednokratni kalupi I dio. Strojarski fakultet u Slavonskom brodu, 2001.</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	COMPUTER AIDED DESIGN 1						
Code	FEEE11	Year of study	2				
Course teacher	Gojko Magazinović, Ph. D., Full Professor	Credits (ECTS)	5				
Associate teachers	Ivan Pivac, Teaching assistant.	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	50				

COURSE DESCRIPTION

Course objectives	Training students for: - understanding and application of basic terms and principles of feature-based modeling, parametric modeling, and geometric modeling, - ability to build simple models, assemblies, and technical drawings by using a geometric modeling tool.
Course enrolment requirements and entry competences required for the course	-
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - explain fundamental principles of geometric modeling, parametric modeling, and feature based modeling, - describe an importance and available approaches to the exchange of design data between the different CAD systems, - explain the fundamental principles of the parametric curve and parametric surface definitions, - use a computer aided design tool, - construct simple geometric models and assemblies, - determine the model cross-section properties, - determine the model mass properties.

Course content broken down in detail by weekly class schedule (syllabus)	Course content	L or S hours	AE hours
	Introduction to a course. Description of an e-learning portal.	2	
	Introduction to CAD/CAM/CAE systems, part I: basic terms.	2	
	Introduction to CAD/CAM/CAE systems, part II: applications; the expansion of 3D CAD technology.	2	
	Elements of CAD/CAM/CAE systems; hardware; software.	2	
	Geometric modeling; feature based modeling; parametric modeling.	2	
	Introduction to graphics programming, part I: OpenGL; coordinate systems; homogeneous coordinates; coordinate transformations.	2	
	Introduction to graphics programming, part II: hidden line removal; rendering; shading; ray-tracing.	2	
	First midterm exam		
	CAD data structures; exchange of design data between the different CAD systems.	2	
	Parametric curves, part I: Hermite curve.	2	
	Parametric curves, part II: Bezier curve; B-Spline curve.	2	
	Parametric curves, part III: interpolation curve; geometric continuity; NURBS curves.	2	
	Parametric surfaces: bilinear surface; Bezier surface; B-Spline surface; NURBS surface.	2	

	Modeling and analysis (A brief on structural analysis).	2	
	Second midterm exam		
	List of laboratory or design exercises		LE or DE hours
	The environment of CAD design tool; extrusion of a closed curve.		2
	Sketch tool; extrude; round; chamfer; hole; parameters.		2
	Simple model editing.		2
	Revolving of a closed curve.		2
	Design planes.		2
	Sections; shells, constraints; sketching utilities.		2
	Translation patterns; one- and two-dimensional.		2
	Radial patterns of set features.		2
	Radial patterns of built features; feature copying.		2
	Helical sweep.		2
	Making assemblies.		2
	Technical drawing preparation, part I.		2
	Technical drawing preparation, part II.		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 ☒ computer work (other)
Student responsibilities	Attendance of at least 70% lectures and all design 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		Practical training	
	Experimental work		Report		Individual work	0,8
	Essay		Seminar essay		Computer work	2
	Tests	0,2	Oral exam		(Other)	
	Written exam		Project		(Other)	

Grading and evaluating student work in class and at the final exam	There are two midterm exams during the semester (carried out by using computer and e-learning portal; 90 minutes duration; each exam: 25 theoretical questions and two design problems). The final exams attend students that didn't pass the midterm exams. The requirements for passing grade are the fulfillment of student responsibilities and at least 50% points on each midterm exam or the final exam. Grade (in percentage) is determined as follows: Grade(%) = (M1 + M2)/2 where M1 and M2 are the midterm grades. The final grades are: satisfactory (2), grades from 50% to 61%; good (3), grades from 62% to 74%; very good (4), grades from 75% to 87%; and excellent (5), grades from 88% to 100%.

Required literature (available in the library and via other media)	**Title**	**Number of copies in the library**	**Availability via other media**
	G. Magazinović, Bilješke uz predavanja, FESB	-	e-learning portal
	R. Toogood: Creo Parametric 2.0 Tutorial and Multimedia DVD, SDC Publications, Mission, 2013.	1	https://books.google.hr

Optional literature (at the time of	- K. Lee: Principles of CAD/CAM/CAE Systems, Addison-Wesley, Reading, 1999.

submission of study programme proposal)	- C. McMahon, J. Browne: CADCAM: Principles, Practice and Manufacturing Management, Prentice-Hall, Harlow, 1998.
Quality assurance methods that ensure the acquisition of exit competences	- Evaluation of results by the above learning outcomes - Feedback from students via surveys - Institutional and non-institutional evaluations
Other (as the proposer wishes to add)	

NAME OF THE COURSE	**MECHANICS OF MATERIALS**						
Code	FESE02	Year of study	2.				
Course teacher	Frane Vlak, Ph. D., Associate Professor	Credits (ECTS)	7				
Associate teachers	Marko Vukasović, Ph. D., Teaching 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: - explain plane stress, plane strain and stress-strain relationship (Hooke's law), - analyse plane stress using Mohr's circle, - calculate geometrical properties of cross sections, - determine stress and displacements of beams under tension/compression, torsion and bending, - apply developed procedures to analyse and design simple structures (allowable stress and strain design), - solve statically indeterminate problems using the method of integration of the deflection curve and the method of equating displacements , - analyse beams under combined loadings using failure theories, - 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
	Shear. Statically indeterminate problems in tension/compression. Thermal effects, misfits and prestrains.	3	2
	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	2,6	Research		Practical training	
	Experimental work		Report		Individual work	4,1
	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)

<table>
<tr><td></td><td colspan="3">the activities in percentage:
• M1, M2 – test results.</td></tr>
<tr><td rowspan="5">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>Alfirević, I: Nauka o čvrstoći I, Tehnička knjiga, Zagreb, 1989.</td><td>5</td><td></td></tr>
<tr><td>F. Vlak: Autorizirana predavanja, FESB</td><td></td><td>e-learning portal</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">Craig, R., R.: Mechanics of Materals, John Wiley & Sons, New York, 2000.</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="6">TECHNOLOGY 2</td></tr>
<tr><td>Code</td><td>FETE02</td><td>Year of study</td><td colspan="5">2</td></tr>
<tr><td>Course teacher</td><td>Dražen Bajić, Ph. D., Full Professor
Branimir Lela, Ph. D., Assistant Professor</td><td>Credits (ECTS)</td><td colspan="5">6</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Sonja Jozić, Ph.D., Assistant Professor,
Jure Krolo, Teaching assistant
Mario Veić, 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>45</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">10%</td></tr>
<tr><td colspan="7">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="6">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.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="6">None.</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:

- categorize metal forming processes and metal removal processes
- discuss the use of machining and metal forming technologies
- outline procedures and machines used in metal forming processing
- comment conditions of flow 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
- discuss expressions to calculate the cutting speed, material removal volume, cutting force, torque, power, theoretical roughness and the main machine time for particular machining operations
- analyze the mechanics of orthogonal and oblique cutting
- discuss the mechanisms and forms of tool wear in machining
- examine the economic aspect of machining with respect to various criteria</td></tr>
<tr><td rowspan="8">Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="4">Course content</td><td>L hours</td><td>AE hours</td></tr>
<tr><td colspan="4">Introduction. Classification of metal-removal processes. Basic features particular machining procedures.</td><td>3</td><td>/</td></tr>
<tr><td colspan="4">Parameters of cutting. Basic principles, tool and workpiece motion.</td><td>3</td><td>/</td></tr>
<tr><td colspan="4">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>3</td><td>/</td></tr>
<tr><td colspan="4">Cutting forces, power, vibrations during machining. Thermal phenomena in cutting.</td><td>3</td><td>/</td></tr>
<tr><td colspan="4">Tribology of machining process</td><td>3</td><td>/</td></tr>
<tr><td colspan="4">Integrity of machined surface.</td><td>3</td><td>/</td></tr>
<tr><td colspan="4">Cutting-tool materials. High speed machining.</td><td>3</td><td>/</td></tr>
</table>

	First midterm exam		
	Introduction; Classification of deformation processes; Concept of plastic deformation;	3	/
	Material plasticity indicators; Changes in the material caused by deformation; Anisotropy;	3	/
	Deformation strain and strain rate; Flow stress and flow curves; Yield criteria;	3	/
	Upsetting processes; Forging processes; Drawing processes	3	/
	Extrusion processes; Rolling processes;	3	/
	Sheet metal bending; Deep drawing and spinning processes; Stamping processes;	3	/
	Second midterm exam		
	List of laboratory exercises		LE hours
	Turning, Tool and workpiece geometry, Chip shapes, Cutting-tools materials, 1st part		2
	Turning, Tool and workpiece geometry, Chip shapes, Cutting-tools materials, 2nd part		2
	Planing and slotting, compression rate measurement		2
	Drilling, sinking, and reaming. Measuring the axial force and torque for drilling		2
	Sawing, broaching. Measuring the main cutting force for turning using the power consumption.		2
	Milling. Measuring the surface roughness in relation with cutting parametars.		2
	Grinding, honing, superfinishing. Measuring the cutting forces using three component dynamometer		2
	Deformation influence on material mechanical properties		2
	Material flow investigation		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
	Investigation of material formability by extrusion; Material springback effect determination 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: 1. Positive assessment of laboratory exercises

<table>
<tr><td></td><td colspan="3">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% 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</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>Duplančić, I.: “Obrada deformiranjem”, Sveučilište u Splitu, FESB, Split 2007.</td><td>5</td><td></td></tr>
<tr><td>Bajić, D. “Obrada odvajanjem”, autorizirana predavanja.</td><td></td><td>e-learning portal</td></tr>
<tr><td>Ekinović S.: “Postupci obrade rezanjem”, Univerzitet u Sarajevu, Mašinski fakultet u Zenici, 2003.</td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="3">- Povrzanović, A. “Obrada metala deformiranjem – odabrana poglavlja”, Sveučilište u Zagrebu, Fakultet strojarstva i brodogradnje, Zagreb, 1996.
- 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.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="3">- 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</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="3"></td></tr>
</table>

NAME OF THE COURSE	COMPUTER- AIDED ANALYSIS						
Code	FESE17	Year of study	2				
Course teacher	Damir Vučina, Ph. D., Full Professor	Credits (ECTS)	5				
Associate teachers	Igor Pehnec, Ph. D., Assistant Professor Ivo Marinić- Kragić, Teaching assistant	Type of instruction (number of hours)	L	S	AE	LE	DE
			30	0	0	30	0
Status of the course	Obligatory	Percentage of application of e-learning	0				

COURSE DESCRIPTION

Course objectives	Acquiring theoretical know-how in basic numerical methods in engineering. Developing competences in modeling engineering problems for numerical methods. Developing practical skills in developing Matlab code for engineering problems.		
Course enrolment requirements and entry competences required for the course	Competences acquired in courses Mathematics I, Mechanics I		
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	After completing the course, students will be able to: • Explain the basic setup of computers, • Describe the procedure of developing programs, • MATLAB 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 MATLAB		
Course content broken down in detail by weekly class schedule (syllabus)	Course content	L hours	AE hours
	Introduction to computers, binary system, logic functions. Introduction to computer-aided analysis.	2	
	Basics of numerical procedures and analysis, simple algorithms.	2	
	MATLAB - language programming part 1	2	
	MATLAB -language programming part 2	2	
	Developing flowcharts and pseudo-code, part 1	2	
	Developing flowcharts and pseudo-code, part 2	2	
	Elementary numerical procedures and engineering applications (mechanics, fluid mechanics, thermodynamics)	2	
	Engineering application of numerical methods: Solving linear systems	2	
	Engineering application of numerical methods: Solving nonlinear equations and systems.	2	
	Engineering application of numerical methods: Interpolation by polinomials and piecewise polynomials	2	
	First midterm exam		
	Engineering application of numerical methods: Approximation using polinomials.	2	

	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 MATLAB.	2	
	Second midterm exam		
	List of laboratory exercises		LE hours
	MATLAB, workspace, compiler, linker. Basic terms of MATLAB, Types, operators, expressions.		2
	Declaring variables, formatted output, data input.		2
	Conditional expressions. Branching, if, if-else, if-else if-...-else		2
	Loops, while(), do-while(), for().		2
	Files, fopen(), fprintf(), fscanf(), load(), dlmread(), dlmwrite()…		2
	Matrix operations. Operators at the level of elements		2
	Functions, declaration, definition, passing arguments		2
	2D and 3D graphics in MATLAB		2
	Introduction to numerical methods. Linear systems		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
	Introduction to numerical methods. Approximation and interpolations.		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	**THERMODYNAMICS**						
Code	FESE05	Year of study	3				
Course teacher	Frano Barbir, Ph. D., Full Professor	Credits (ECTS)	6				
Associate teachers	Ivan Tolj, Ph. D., Teaching 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					
COURSE DESCRIPTION							
Course objectives	Training students for: - understanding of the basic concepts and laws of thermodynamics - application of the concepts and laws of thermodynamics to energy processes and systems						
Course enrolment requirements and entry competences required for the course	Mathematics 2						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - explain the basic concepts and laws of thermodynamics - apply the concepts and laws of thermodynamics to the different types of a simple technical energy process						

<table>
<tr><td></td><td colspan="3">- calculate the mass balance and simple balance of different types of energy flows
- calculate the efficiency of the process and energy systems
- link effects of all studied processes by changes in the environment</td></tr>
<tr><td rowspan="19">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>The subject of thermodynamics, two external impacts (work, heat) and pressure, volume and temperature as state functions. State equation of ideal gas.</td><td>3</td><td>2</td></tr>
<tr><td>Two ways to express quantity of the substances. Mixture of ideal gases. Thermal expansion of solids and liquids.</td><td>3</td><td>2</td></tr>
<tr><td>The first law of thermodynamics, internal energy and its connection with measurable state functions. Caloric state equation of ideal gas. Application of the first law on ideal gas.</td><td>3</td><td>2</td></tr>
<tr><td>Isobaric, isochoric, isothermal and adiabatic processes. Polytropic processes. Cycle processes. Otto, Diesel and Carnot cycle. Internal and external non-equilibrium processes.</td><td>3</td><td>2</td></tr>
<tr><td>The second law of thermodynamics. Two consequences of the second law. The analytical expression of the second law for equilibrium processes. Connection of entropy with measurable state functions of ideal gases. The analytical expression of the second law of nonequilibrium processes.</td><td>3</td><td>2</td></tr>
<tr><td>Flow processes. Enthalpy and technical work. The first law of thermodynamics for flow processes. The term for steady work flow process. Damping. Typical technical flow processes with heat exchange without work. The processes with work and without heat.</td><td>3</td><td>2</td></tr>
<tr><td>Real gases – p-V diagrams instead of the state equation Molière h-s diagram and T-s diagram. Using charts and tables. Rankine Clausius cycle with and without steam overheating. The concept of regeneration, efficiency and simplified schemes of steam - power plants.</td><td>3</td><td>2</td></tr>
<tr><td>Knowledge test – first midterm exam</td><td>3</td><td></td></tr>
<tr><td>Cooling power plants cycles and coefficient of performance. The main properties of refrigerants. Heat pumps.</td><td>3</td><td>2</td></tr>
<tr><td>Humid air and h-x diagram. Humid air typical processes.</td><td>3</td><td>2</td></tr>
<tr><td>Fuel combustion. Numerical characterization of the fuel and combustion: heat of combustion, adiabatic combustion temperature and ignition temperature of the fuel. Required air amount. Determination of air excess from the composition of the combustion products.</td><td>3</td><td>2</td></tr>
<tr><td>Heat transfer: three different mechanisms. Heat conduction.</td><td>3</td><td>2</td></tr>
<tr><td>Convective heat transfer. The physical mechanism of convection, heat transfer coefficient and Nu number. The process of determining the heat transfer coefficient</td><td>3</td><td>2</td></tr>
<tr><td>Heat transfer by radiation. The term black body and "black" radiation. Overall heat transfer coefficient, ribs surface. Heat exchangers. Heat exchanger calculations.</td><td>3</td><td>2</td></tr>
<tr><td>Knowledge test – second midterm exam</td><td>3</td><td></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>Format of instruction</td><td>☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td colspan="2">☐ independent assignments
☐ multimedia
☐ laboratory
☐ work with mentor
☐ (other)</td></tr>
</table>

<table>
<tr><td>Student responsibilities</td><td colspan="6"></td></tr>
<tr><td rowspan="6">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>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>1</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 colspan="6"></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. Upon completion of the semester the first and second final exam are held as well as corrective and commission exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. The midterms are carried out as written tests. The requirement for passing grade is 50 % points on each midterm exam.

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

Grade(%) = (M1+M2)/2
M1, M2 – test results

The final grade is determined by applying an absolute way of evaluation. The final grade is determined according to the points as follows: from 50% to 61% of the points score mark (2), from 62% to 74% mark (3), from 75% to 87% of the points mark (4) , from 88% to 100% mark (5)

Under Article 71 of the Faculty Statute, the student is required to participate in all forms of teaching and attend lectures and exercises at least 70%. If students do not meet these requirements they will not be allowed to write exams.</td></tr>
<tr><td rowspan="6">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">O. Fabris, Osnove Inženjerske termodinamike, Pomorski fakultet Dubrovnik, 1994</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"></td><td></td><td></td></tr>
<tr><td colspan="3"></td><td></td><td></td></tr>
<tr><td>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">- I. Ninić, Uvod u termodinamiku i njene tehničke primjene, Sveučilište u Splitu, 2007.
- F. Bošnjaković, Nauka o toplini I dio, Školska knjiga Zagreb, 1976.</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	DESIGN OF INDUSTRIAL PRODUCTS						
Code	FESE04	Year of study	3				
Course teacher	Željko Domazet, Ph. D., Full Professor Lovre Krstulović-Opara, Ph. D., Full Professor	Credits (ECTS)	5				
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 10 learning outcomes)	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. - 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

<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
☒ Group work- product developement</td></tr>
<tr><td>Student responsibilities</td><td colspan="6"></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>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>1</td></tr>
<tr><td>Essay</td><td></td><td>Seminar essay</td><td>2</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">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.</td></tr>
<tr><td rowspan="6">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">Design of industrial products (in Croatian)</td><td></td><td>E-learning</td></tr>
<tr><td colspan="3">Additional course materials</td><td></td><td>E-learning</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>Optional literature (at the time of submission of study programme proposal)</td><td colspan="6">Otto, K. N., Wood K. L., Product Design, Prentice Hall, New York, 2001.
Quarante D. Osnove industrijskog dizajna, Sveučilišna naklada Zagreb, 1991.</td></tr>
<tr><td>Quality assurance methods that ensure the acquisition of exit competences</td><td colspan="6">- Student evaluations
- Registering student’s attendance to course</td></tr>
<tr><td>Other (as the proposer wishes to add)</td><td colspan="6"></td></tr>
</table>

NAME OF THE COURSE	INTRODUCTION TO INFORMATION SYSTEMS						
Code	FESE06	Year of study	3				
Course teacher	Damir Vučina, Ph. D. Full Professor	Credits (ECTS)	4				
Associate teachers	Igor Pehnec, Ph. D. Teaching assistant Ivo Marinić- Kragić, Teaching assistant Milan Ćurković, Ph. D., Teaching assistant	Type of instruction (number of hours)	L	S	AE	LE	DE
			30	0	0	15	0
Status of the course	Obligatory	Percentage of application of e-learning	0				

COURSE DESCRIPTION

Course objectives	Capability of applying computers in building information systems. Acquiring knowledge and application skills: HTML, basic terms in databases, basics of SQL, script languages, active web pages, IS
Course enrolment requirements and entry competences required for the course	Completed pre-graduate studies which include courses equivalent to Computer-aided analysis. Competences in basic engineering analysis methods and program development in MATLAB
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	After completing the course, students will be able to: • Describe information systems, specify architecture and functionality, elements, technologies • Develop sets of HTML files for the IS • Develop simple client scripts in Vbscript • Create simple databases • Develop simple SQL queries • Build simple dynamic web pages using ASP

Course content broken down in detail by weekly class schedule (syllabus)

Course content	L hours	AE hours
Introduction. systems, business processes, information processing	2	
Information systems IS, MIS, elements of IS	2	
Information systems IS, functional specifications of IS, architecture of IS	2	
Infrastructure and devices for the IS, protocols	2	
Internet, services, www	2	
Development of content for the web	2	
Basics of HTML	2	
Basics of programming, basic elements of programs	2	
Script languages, Vbscript	2	
Databases: basic terms and elements of design	2	
First midterm exam		
Databases: basics of SQL, IS and databases	2	
Simple active pages, ASP. Basic concepts of web applications	2	
Integration of IS elements	2	
Second midterm exam		
List of laboratory exercises		LE hours
Information systems IS modeling, functional specifications of IS		1

	Develop sets of HTML files for the IS	2
	Scripting and Vbscript examples	2
	Databases, modelling, normalization	2
	SQL	2
	Active pages, ASP, applications	2
	Integration of IS	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	1
	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, M. Šušnjar, M. Uvodić 'Uvod u informacijske sustave', internal material		
	Steven Alter, 'Information Systems: Foundation of E-Business		
	Ch J. A. O'Brien, 'Management Information Systems', Irwin Inc.		
	Online skripts: w3schools - 'HTML', 'VBScript', 'ASP', 'SQL'		

Optional literature (at the time of submission of study programme proposal)	• NCSA, 'A Beginner's Guide to HTML', ili ' • HTML - An Interactive Tutorial for Beginners' • MS VBScript Tuturial • MS ASP pages R. Leinecker, 'Using ASP.net', Que, 2002
Quality assurance methods that ensure	- Evaluation of results in accordance with the above learning outcomes - Feedback from students via surveys

the acquisition of exit competences	- Self-evaluation of teachers - Institutional and non-institutional evaluations
Other (as the proposer wishes to add)	