

## UNIVERSITYOFSPLIT

FACULTY OF ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE

## DETAILED PROPOSAL OF THE STUDY PROGRAMME

UNDERGRADUATE VOCATIONAL STUDY IN ELECTRICAL ENGINEERING

SPLIT, February 2022

## 1.1. List ofmandatory and elective courses

List ofcourses										
Year of study:1.										
Semester: II	Semester: II.									
OTATUO	CODE	COURSE	HOURS IN SEMESTER					FCTS		
31A103	CODE	COURSE	L	S	AE	LE	DE	ECIS		
Mandatory	FEMY02	Applied Mathematics	30	0	30	0	0	5		
Mandatory	L = lectures	s, S = seminars, AE = auditoryexcercise, LE = laborat	oryexce	rcise, I	DE = de	esign e	xcercis	Э		

List ofcourses										
Year of study:2.										
Semester: II	Semester: III.									
	CODE	COURSE	HOURS IN SEMESTER			ER	FCTS			
	CODE	COURSE	L	S	AE	LE	DE	ECIS		
STATUS	FENO07	Power Electronics	45	0	0	30	0	6		
	FENO08	Control Engineering	30	0	15	15	0	5		
	L = lectures	s, S = seminars, AE = auditoryexcercise, LE = laborat	oryexce	rcise, I	DE = de	esign e	xcercis	e		

List ofcourses									
Year of study:2.									
Semester: IN	<i>l</i> .								
STATUS	CODE	COURSE	НО	URS	IN SE	MEST	ER	ECTS	
	CODE	COOKSE	L	S	AE	LE	DE	ECIS	
	FENO12	Electrical Distribution Networks30015150						5	
	L = lectures	, S = seminars, AE = auditoryexcercise, LE = laborat	oryexce	rcise, I	DE = de	esign e	xcercise	е	

	List ofcourses									
Year of study:3.										
Semester: V	Semester: V.									
PLITATO	CODE	COURSE	HO	URSI	N SEI	MEST	ER	FCTS		
314103	CODE	COOKCE		S	AE	LE	DE	LOIS		
	FENO15	Electrical Safety	30	0	0	30	0	5		
Mandatory	FENO21	Electronic Converters for Power Supplies	30	0	15	15	0	5		
	FENO29	Renewable Energy Sources	30	0	0	30	0	5		
	L = lectures	s, S = seminars, AE = auditoryexcercise, LE = labora	itoryexce	ercise,	DE = de	esign e	xcercis	e		

List ofcourses									
Year of study	:3.								
Semester: V	′I.								
	CODE	COURSE	HO	URS I	N SEI	MEST	ER	ECTO	
STATUS	CODE	COOKSE	L	S	AE	LE	DE	ECIS	
	FENO22	Power system and environment	30	0	0	30	0	5	
	L = lectures	= lectures, S = seminars, AE = auditoryexcercise, LE = laboratoryexcercise, DE = design excercise							

	List ofcourses									
Year of study:3.										
Semester: V	Semester: V.									
HOURS IN SEMESTER								ECTO		
	CODE		L	S	AE	LE	DE	ECIS		
	FELO44	Biomechanics Practicum	15	0	0	45	0	5		
STATUS	FELO21	Electromagnetic Compatibility	30	0	0	30	0	5		
	FELO30	Radio Communications	30	0	15	15	0	5		
	FELO32	Human Exposure to Electromagnetic Radiation	30	0	0	30	0	5		
	FELO31	Computer Aided Analysis of Radiating Structures	30	0	0	30	0	5		
	L = lectures	_ = lectures, S = seminars, AE = auditoryexcercise, LE = laboratoryexcercise, DE = design excercise								

List ofcourses									
Year of study:3.									
Semester: V	′I.								
	CODE	COURSE	HO	URSI	N SEN	MEST	ER	ECTS	
STATUS	CODE	COURSE	L	S	AE	LE	DE	ECIS	
	FELO36	Sensors and Transducers	30	0	0	15	0	4	
	L = lectures	= lectures, S = seminars, AE = auditoryexcercise, LE = laboratoryexcercise, DE = design excercise							

## 1.2. Course description

NAME OF THE COURSE	APPLIED MATHEMATICS	6					
Code	FEMY02	Year of study	1				
Course teacher	Ivančica Mirošević, M.Sc., Lectuter	Credits (ECTS)	5				
Associate teachers	Lea Dujić	Type of instruction (number of hours)	L 30	S	AE 30	LE	DE
Status of the course	obligatory	Percentage of application of e-learning	10				
	COURSE	DESCRIPTION					
Course objectives	Training students for: - applicationofmathe alequations, n analyzeandsolveer	ematicalconceptsandtoolsf umericalmathematics, ngineeringproblems.	romthea statist	areaof icsanc	ordina Iproba	rydiffe bility	erenti to
Course enrolment requirements and entry competences required for the course	GoodknowledgeofHighSch	oolmathematicsandpasse	d State	Exam	inMath	nemat	ics.
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	<ul> <li>Students will be able to:</li> <li>state definitions and theorems from the enitre course,</li> <li>illustrate theorems with examples,</li> <li>solve some first and second order differential equations,</li> <li>apply Laplace transform to linear differential equations</li> <li>find approximate solution of a nonlinear equation</li> <li>approximate function with Lagrange interpolation polynomial</li> <li>approximate empirical data with constant, linear or quadratic function</li> <li>solve definite integral and Cauchy problem of the first order approximately</li> <li>use statistical techniques in data analysis</li> </ul>						
	Course content				or S	4	١E
	1. Introduction Basicconceptsanddefinitior Equationswithseparableval	ns.	2	nc	2		
	2. Lineardifferentialequations	Homogeneousdifferential	equatio	ns.	2		2
	3. Differentialequ Lineardifferentialequations cients.	ationsof ,theseo ofthesecondorderwithcons	condord tantcoe	ler. effi	2		2
Course content broken down in	4. Laplacetransform InverseLaplacetransformar	<ul> <li>definitionandbasicp ndbasicproperties.</li> </ul>	properti	es.	2		2
detail by weekly class schedule (syllabus)	5. Solvinglineardifferentialequ singLaplacetransform.	ationswithwithconstantcoe	efficient	su	2		2
	6. Introduction Solvingnonlinearequations Bisectionmethod. Iterativer	to Numericalma Graphic Graphic	themati almethe	cs. od.	2		2
	7. Lagrange interpolation p	olynomial			2		2
	8. Leastsquaremethod. A constant, linear or quadrati	Approximating empirical c function.	data w	vith	2		2
	9. Numericalintegration. Euler'smethod for Cauchyp	Trapezoidalrule. Simp problems.	son'sru	ıle.	2		2
	10. Descriptivestatistics. I Numericalcharacteristics.	Discrete data andcontinu	ous da	ata.	2		2

11. Introduction to Probabilitytheory. Elementaryoutcomes. 2 2									
	12. Discreterand	domvari	able.	Expectationan	dvariance.	2	2		
	Binomialdistribution. 13. Continuousra	<u>Poisso</u> ndomva	ndistribut Iriable.	ion. Expectationan	dvariance.		_		
	Normaldistribution.			-		2			
	List oflaboratoryor de	esign ex	rcises				hours		
Format of instruction	<ul> <li>Sectores</li> <li>Seminars and work</li> <li>⊠exercises</li> <li><i>On line</i>in entirety</li> <li>□partial e-learning</li> <li>□field work</li> </ul>	Initial construction       Image: Construction         Image: Constreaction       Image: Constreaction							
Studentresponsibiliti es	Regularattendence t	o andac	ctivepartic	cipationinlecture	esandexcerc	ises.			
Screening student work (name the	Class attendance	2	Researc	h	Practical tra	ining			
proportion of ECTS	Experimental work		Report		Selfstudy		2.6		
eachactivity so that	Essay		Seminai essay		(Othe	er)			
ECTS credits is	Tests	0.2	Oral exa	ım	(Othe	ər)			
value of the course)	Written exam	0.2	Project		(Other)				
Grading and	weeksoflectures, termexam students attainedthroughassig passingthecourseis 50 points. Aftersemester, twofin Students which onlythispartoftheexa Students thefinalexamwithcon	andthes s cang gnemen minimur nalexam ndidnotp mduring w nprehen	secondint jet 40 tsduringle n 20 poin nsand a c pass gfinalexar hichdidno sivecours	heweekfollowin points, whilet ecturesandexce ts on eachmid-t orrectionexam one mid- ns. otpassanymid-te secontent.	gthelectures heremaining rcises. T ermexamsa are held. termexam, ermexam, In	At 20 p Thecondit nd a tota can	eachmid- oints are ion for of at least take take thatcase,		
evaluating student work in class and at the final exam	maximumnumbersofavailablepointsis 80. Thecondition for passingthecourseis minimum 40 pointsinthefinalexamand a total of at least 50 points. The grade isformedafterthesecondfinalexamaccording to article 75 of the Statute of FESB: 15% of the best students get the markexcellent (5)								
	next 35% students g next 35% students g andthelast 15% stud	etthema etthema lents ge	arkverygo arkgood ( tthetmark	ood (4), 3), ssufficient (2).					
Students whodidnotpassthecourseafterfinalexams, andhaveobtained total of a 10 points, canattendthecorrectionexam. thecorrectionexammaximalnumberofpointsis 100, andthe minimum requireme a passing grade is 50 points. Mid-termexams, finalexamsandcorrectionexam heldaccording to theexamschedule.							of at least On rement for exams are		
Required literature (available in the		Title	)		Number of copies in the librar	of Avail otho	ability via er media		
media)	Lecturematerials on	FESB e	e-learning	portal.		https g.1	://elearnin iesb.hr/		

Optional literature (at the time of submission of study programme proposal)	T. Bradić, J. Pečarić, R. Roki, M. Strunje: Matematika za tehnološke fakultete, Element, Zagreb, 1998. B. P. Demidovič: Zbirka zadataka iz više matematike, Školska knjiga, Zagreb 1998. Ivo Pavlić, Statisticka teorija i primjena, Zagreb, 1971
Quality assurance methods that ensure the acquisition of exit competences	<ul> <li>homework</li> <li>short tests</li> <li>quizzes</li> <li>mid-termexams</li> <li>finalexam</li> <li>student questionnaires</li> </ul>
Other (as the proposer wishes to add)	

NAME OF THE COURSE	POWER ELECTRONICS							
Code	FENO07	Year of study	2					
Course teacher	Dinko Vukadinović, Ph.D., Full Professor	Credits (ECTS)	6					
Associate teachers	Mateo Bašić, Ph.D. Assistant Professor Ivan Grgić, Assistant	Type of instruction (number of hours)	L         S         AE         LE           45         0         0         30				DE 0	
Status of the course	Obligatory	Percentage of application of e-learning	0					
	COURS	E DESCRIPTION						
Course objectives	Training students for: - understanding of basic pr - understanding of power c - analysis of rectifiers, inve	inciples of power electroni onverters operating princip rters and non-isolated DC-	cs devid bles -DC con	ces sw vertei	vitching, rs			
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) define ways of power electronics devices switching 2) explain the natural commutation in phase-controlled rectifiers 3) 5nalyse the operation of rectifiers, inverters and non-isolated DC-DC converters 4) adjust the firing angle of full-controlled bridge converter in accordance the desired mean value of the output voltage 5) make the simulation model of the phase-controlled three-phase converter 6) make the simulation model of the buck non-isolated DC-DC converter 7) operate with the buck non-isolated DC-DC converter 8) calculate the power factor of the load connected to the electric grid via the power 9) calculate the thermal resistance of certain power electronics device 10) specifywaysofpowerelectronicsdevicesprotection							
	Course content				L			

							hours	
	Introduction and basi	ic princi	ples of p	ower electr	onics devi	ices	4	
	Ways of power electr commutation	ronics d	evices tu	Irning-off a	nd natural		4	
	Diode rectifiers						4	
	Comparison of the di	ode rec	tifiers				2	
	Thyristor-based conv	verters					4	
	Power flow in electric	c grids v	vith powe	er electronio	cs convert	ers	4	
	AC converters						3	
Course content	Inverters						4	
broken down in	Non-isolated DC-DC converters						5	
class schedule	Direct AC-AC conver	tors					4	
(syllabus)	Heat transfer in now	ar electr	onice de	vices and r	ower			
	electronics devices n	rotectio	n				3	
	List of laboratory exe	rcises	<u></u>					LE
	Resistor and inductor	with a	ower el	ectronics de	evice (sim	ulatio	n)	3
	Natural commutation	(simula	tion)		(			3
	Single-phase full-cont	trolled b	oridge co	nverter for	the DC mo	otor si	upply	6
	Three-phase full-cont	rolled b	ridae cor	overter (sim	ulation an	nd exp	eriments)	6
	Single-phase AC volt	age con	troller (e	xperiments	)	<u></u>		6
	Single-phase AC volta	age con	troller (s	imulation a	nd experir	nents	)	6
	x lectures							
	seminars and workshops					its		
	⊠ exercises							
Format of Instruction	□ <i>on line</i> in entirety							
	□ partial e-learning							
	□ field work							
Studentresponsibiliti es	The presence on lect Performed all require	tures in d labora	the amo atory exe	unt of at lea	ast 70 % o	of the	times schedul	əd.
Screening student	Class attendance	1	Resear	ch	Pra	actica	l training	
proportion of ECTS	Experimental work		Report		Inc	dividua	al work	3
eachactivity so that	Essay		Semina	r essay	Lal	borato	ory exercises	1
ECTS credits is	Midterm exams	0.3	Oral ex	am	Au	ditory	exercises	0.5
equal to the ECTS value of the course)	Written exam	0.2	Project		(O1	ther)		
Grading and evaluating student work in class and at	During the semester, and the second after either theoretical or course which they did The requirement for (L) and the midterma more. The sum is cal	, two mi 13 weel numerid d not pa passing s' grade lculated	dterm ex ks of lect cal. In th iss in the grade is es (M1 a as 75(M1 +	ams are he ures. Each e final exa midterm e s that the s ind M2), ex	eld – the fi midterm e ms, stude xams. um of the cpressed a	irst aff exam ( ents ta labor as a j	ter 7 weeks of consists of 4 p ake those par atory exercise percentage, is	lectures roblems, ts of the s' grade 50% or
	Grade (%) = 0.25	.∪ + 0.3		ivi∠)				
	where the number of	points	achievec	l in each mi	idterm exa	am ha	s to be at leas	t 50%.
	The students that do consists of 4 problem at least 50% points a	o not pa ns. The achieved	ss the m requiren d. In the	nidterm exa nent for a p final exam,	ims take t positive ev the stude	the fin aluati ents th	al written exa on of the final at did not pas	m which exam is is one of

	he midterm exams are presented with 4 problems from the corresponding part of the course. Subsequently, the grade is determined as follows:							
	Grade (%) = 0.25L + 0.75(I)							
	where I is the number of points achieved in the final w	written exam (a	at least 50%).					
	The final grade for the course is determined as follow	The final grade for the course is determined as follows:						
	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	Title	Number of copies in the library	Availability via other media					
media)	D. Vukadinović, Lj. Kulišić: Predavanja iz energetske elektronike za šk. god. 2013/14		e-learning portal					
	D. W. Hart: Power Electronics, McGraw-Hill, 2011.		e-learning portal					
Optional literature (at the time of submission of study programme proposal)	N. Mohan, T. N. Undeland, T. N. Robbins, Power Ele Applications, and Design, 3nd Edition, John Wiley√S	ctronics: Conv ons, 2003.	rerters,					
Quality assurance methods that ensure the acquisition of exit competences	<ul> <li>Keeping records of student attendance</li> <li>Annual analysis of the performance at midterm exams and final exams</li> <li>Feedback from students via surveys</li> <li>Self-evaluation of teachers</li> <li>Feedback from graduated students</li> </ul>							
Other (as the proposer wishes to add)								

NAME OF THE COURSE	CONTROL ENGINEERING							
Code	FENO08	Year of study	2					
Course teacher	Mateo Bašić, Ph.D., Assistant Professor	Credits (ECTS)	5					
		Type of instruction	L	S	AE	LE	DE	
Associate teachers		(number of hours)	30	0	15	15	0	
Status of the course	Obligatory	Percentage of application of e-learning	0					
	COURS	E DESCRIPTION						
Course objectives	Training students for: - understanding and app - analysis and synthesis	plication of basic principles of automatic control syste	of auto ms.	matic	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)	<ul> <li>Students will be able to:</li> <li>solve by calculation specific engineering problems in the field of automatic control,</li> <li>describe the basic components of automatic control systems</li> <li>sketch Nyquist and Bode plots of automatic control systems,</li> <li>apply Laplace transform and block algebra in the analysis and synthesis of automatic control systems,</li> <li>calculate the stability and quality indicators of automatic control,</li> <li>carry out the experimental analysis and synthesis of the passive R-C elements typically found in automatic control systems,</li> <li>experimentally test the dynamic quality indicators of an air-temperature control system,</li> </ul>							
	Course content				L hours	h	AE ours	
	Basic concepts of automat automatic control systems	ic control and classification	n of		2		0	
	Laplace transform, elemen evaluation of the time function		2		1			
	Frequency domain analysis	s: Nyquist and Bode metho	ods		2		1	
	Transfer functions and time		2		1			
Course content	Frequency characteristics		2		1			
broken down in	DC machine as an object o	of control			2		1	
class schedule	Transfer functions of multile (block algebra)	oop automatic control syste	ems		2		1	
(Syllabus)	First midterm exam							
	Stability of automatic contro Hurwitz, Nyquist, and Bode	ol systems. Stability criterio a.	ons by		2		1	
	Control quality indicators				2		1	
	PID controllers: subtypes a method of tuning the PID c	nd discrete form. Ziegler–l ontroller parameters.	Nichols		2		1	
	Experimental synthesis of a a DC motor	a cascade speed-control s	ystem o	of	1		1	
	Synthesis of linear systems parallel correction)	s of automatic control (seria	al and		1		1	

(available in the		Title			copie the lib	s in rarv	other	media	
Required literature		<b>T</b> : (1			Numb	er of	Availat	oility via	
	50% to 61% - Sutfici 62% to 74% - Good 75% to 87% - Very g 88% 100% - Exceller	ent (2) (3) good (4) nt (5)							
	FOW to 61%	e cours	e is dete	rmined as fo	DIIOWS:				
	where I is the number of points achieved in the final written exam (at least 50%).								
	Grade (%) = 0.2	5L + 0.7	(5(I)		1				
	course. Subsequently, the grade is determined as follows:								
the final exam	at least 50% points achieved. In the final exam, the students that did not pass one of the midterm exams are presented with 4 problems from the corresponding part of the								
evaluating student	The students that do not pass the midterm exams take the final written exam which consists of 4 problems. The requirement for a positive evaluation of the final exam is								
Grading and	where the number of points achieved in each midterm exam has to be at least 50%.								
	Grade $(70) = 0.231 \pm 0.373$ (NT + NZ) where the number of points achieved in each midterm even has to be at least 50%								
	Grade $(\%) = 0.25$	50 + 0 3	75(M1 ⊥	M2)					
	The requirement for passing grade is that the sum of the laboratory exercises' grade (L) and the midterms' grades (M1 and M2), expressed as a percentage, is 50% or more. The sum is calculated as								
	and the second after 13 weeks of lectures. Each midterm exam consists of 4 problems, either theoretical or numerical. In the final exams, students take those parts of the course which they did not pass in the midterm exams.								
value of the course)	During the semester		dtorm or	ame are he		) oftor 7		floctures	
ECTS credits is equal to the ECTS		0.2	Droiget	a111				0.0	
eachactivity so that the total number of	ESSay	0.0	Semina	ressay				0.5	
credits for			Report	r. 000001/				2.1	
work (name the	Class attendance	1	Researd	cn	Practi		lining	0.7	
es Screening student	Performed all require	d labora	atory exe	ercises.	Dest		i.a.i.a		
Studentresponsibiliti	The presence on lect	ures in	the amo	unt of at lea	st 70 % of th	e time	es schedu	led.	
	□ partial e-learning								
Format of instruction	<i>□on line</i> in entirety			⊠ laborato	ry h montor				
-	⊠ exercises	vanoha		⊠ multime	dia				
	☑ lectures	cehone		□ indepen	dent assignn	nents			
	Speed control system	of a se	parately	excited DC	motor			3	
	Air-temperature contr	ol syste	m					3	
	Bode magnitude and	<u>o eleme</u> phase r	ents plots					3	
	Passive circuits with I	R-C eler	<u>ments</u>					3	
	List of laboratory exe	List of laboratory exercises						hours	
	Second midterm exa	Second midterm exam						I F	
	State-space representation of a system						2	1	
	control systems	310HH, 3	control systems						

library and via other media)	<ul> <li>Vukadinović, D.,</li> <li>"PredavanjaizRegulacijsketehnike za šk. god.</li> <li>2010/11", FESB, Split, 2014.</li> </ul>	e-learning portal
Optional literature (at the time of submission of study programme proposal)	- Goodwin, G.C., Graebe, S.F., Salgado M.E., "Co Hall, 2001.	ntrol System Design", Prentice
Quality assurance methods that ensure the acquisition of exit competences Other (as the proposer wishes to add)	<ul> <li>Keeping records of student attendance</li> <li>Annual analysis of the performance at laboratory</li> <li>Annual analysis of the performance at midterm e</li> <li>Feedback from students via surveys</li> <li>Self-evaluation of teachers</li> </ul>	exercises xams and final exams

NAME OF THE COURSE	ELECTRICAL DISTRIBUTION NETWORKS							
Code	FENO12	Year of study	2					
Course teacher	Damir Jakus, Ph.D. Assistant Professor	Credits (ECTS)	5					
Associate teachers	Josip Vasilj, Ph.D.	Type of instruction (number of hours)	L 20	S	AE	LE	DE	
Status of the course	Mandatory	Percentage of application of e-learning	30	0	15	15		
	COURS	E DESCRIPTION	•					
Course objectives	<ul> <li>Training students for:</li> <li>Understanding the and operation as w</li> <li>Development of mostationary condition</li> <li>Understanding the earthing</li> <li>Calculation of shor</li> <li>Selection of netwo and ability to propose and ability to propose conditions</li> <li>Deepening the base distribution</li> </ul>	specifics related to the ne vell as network element co odels for the distribution ne specifics related to the dis t circuit currents in distribu- rk elements while respecti- ose measures for the netw effects of distribution gen sic knowledge in the field c	twork s nstruct etwork stribution ng the ork ope eration	structure ion analysi on netw etworks technic eration i n conne	e, grid s undo ork ne al req mprov ction o nsmis	plann er eutral uiremen on netv sion a	ing ents ts vork nd	
Course enrolment requirements and entry competences required for the course Learning outcomes	None							
expected at the level of the course (4 to	Students will be able to:							

10 learning	- Identify the typical structures of the distribution networks and their components							
outcomes)	with all their specifics							
	- Determine the equivalent circuits of distribution network elements for different type							
	- Determine the equivalent circuits of distribution network element	nts for all	erent type					
	- Perform the distribution network power flow and voltage conditions analysis using							
	specialized software packages							
	- Simulate the impact of distributed generation connection on distribution network							
	conditions							
	- Parametrize the distribution network elements to ensure norma	al network	operation					
	- Select low voltage network protection devices and dimensione	ed IS 10/	0.4 kV					
	- To carry out a techno-economic analysis of the excessive cons	umption o	of reactive					
	power and to propose measures for power factor improvement							
	- Simulate the operation of the distribution network and to calcula	ate energy	/ losses					
		L or S	AE					
		hours	hours					
	1. DISTIRIBUTION NETWORK POSITION AND ROLE IN ELECTRIC POWER SYSTEMS							
	- production, transmission and distribution of electrical energy	2						
	- basic characteristics and differences of transmission and							
	distribution networks							
	2. DISTIRBUTION NETWORK TOPOLOGY AND STRUCTURE:	0						
	- Middle Voltage network structure	2						
	3. DISTIRBUTION NETWORK SUBSTATIONS:							
	- Distribution substations	2						
	- Examples of real distribution substations 110/35 V, 35/10 kV	2						
	4. BASIC ELECTRIC PARAMETERS AND EQUIVALINET							
	- Symmetrical components system	0						
	- Physical interpretation of direct, inverse and zero system	2						
	- Calculation of element impedances							
Course content	- Three phase fault							
broken down in	- Two phase fault	3						
detail by weekly	- Single phase faults							
class schedule	6 DISTRIBUTION NETWORK FAULT ANALYSIS (PART 2)							
(syllabus)	- Transformer earthling options in middle voltage distribution							
	networks							
	- Single phase faults	2						
	<ul> <li>Single phase faults in networks earthed using low-ohm registers</li> </ul>							
	- ground faults in unearthed networks							
	- Examples of fault analysis calculations							
	7. APROXIMATIVE NETWORK ANALYSIS UNDER							
	STATIONARY CONDITIONS							
	networks	0						
	- Approximate voltage drop calculations	2						
	<ul> <li>Rating power lines and transformers based on load flow and units and dram advantations.</li> </ul>							
	- Examples of load flow and voltage profile calculations							
	8. LOAD FLOW CALCULATION USING BACKWARD-							
	FORWARD METHOD							
	- Formation of incidence matrix: BIBC, BCBV, DLF	3						
	- Load flow calculations in radial distribution networks							
	networks							
	9. LOW VOLTAGE DISTRIBUTION NETWORKS (PART 1)	2						

	-	- Specificities o	f low volt	tage distrik	oution ne	etworks			
		- Low voltage d	listributio	n network	types ba	ased on e	earthing		
	1	type							
		<ul> <li>Load modelin</li> </ul>	g and loa	ad flow cal	culations	S			
	·	<ul> <li>Load flow / vo</li> </ul>	Itage cor	nditions ca	lculatior	าร			
	10.	LOW VOLTAG	E DISTR	IBUTION	NETWO	ORKS (PA	ART 2)		
		<ul> <li>Planning and</li> </ul>	design o	of low volta	ge netw	orks			
		<ul> <li>Network prote</li> </ul>	ection and	d fuse sele	ection cri	iteria		2	
		<ul> <li>Grounding system</li> </ul>	stem cale	culation in	low volta	age distri	bution		
	I	networks							
	11.	ACTIVE POWE	R/ENEF	RGY LOSS	CALCU	JLATION			
		<ul> <li>Power/energy</li> </ul>	loss cla	ssification					
	-	- Power losses	in transf	ormers an	d power	lines		2	
		- Energy loss c	alculation	ns using a	pproxim	ate appro	bach and		
		using load dura	tion curv	/e	TION				
	12.	REACTIVE PO	WERCO	JMPENSA	TION				
		- Individual/gro	up/centra	al/mixed co	ompensa	ation		2	
		<ul> <li>Positive effect</li> </ul>	ts of read	ctive powe	r compe	ensation			
	·	<ul> <li>Dimensioning</li> </ul>	of capad	citors bank	S				
	13.	IMPACT OF DI	STRIBU	TED GEN	ERATIO	N CONN	IECTION		
		<ul> <li>Impact on net</li> </ul>	work vol	tage condi	tions an	d control			
	-	- Impact on net	work los	ses				2	
		- Impact on net	work pro	tection					
		- Higher harmo	nics, volt	age/currer	nt asymr	metry, flic	CKErs		
	14.	DISTIRBUTION			RATION	I AND CO	JNTROL		
		- Supervision, o	control, S	SCADA		.1		2	
		- Network relian	bility and	energy no	ot served	נ			
	· ·	- MTU system							
	List of Jaboratory or design exercises							LE or DE	
	1	Proparing for			oc and (	domons	tration of cof	tworo	hours
	1.	tools used in	exercis	es		uemons		Iwale	2
	2.	Load flow / v	oltage c	conditions	/ power	r losses	analvsis and	ł	•
		compensatio	n of rea	ctive pow	er in th	e distrib	ution netwo	ks	3
	3.	The preparat	orv exe	rcise for t	he load	flow ca	Iculations in	low-	
	•	voltage distri	bution n	networks					3
	4.	Low-voltage	distribut	tion netwo	ork proi	iect: load	d modelina /	load flow	
		/ voltage cal	culations	s: selectio	on and r	rating of	lines and		
		transformers	short c	circuit ana	lvsis s	election	and complia	ance	2
		testing of fus	es aroi	ind resist	ance ca	alculatio	n and design	n of pole	-
		mounted sub	etation	10/0.4  k	/ earthir	na (Part	1)		
	5		distribut	tion notw	ork proi	ioct: load	1) 1 modeling /	load flow	
	5.		ulation		on and r	roting of	lines and	ioau now	
		/ vollage call	chort c	s, selectic			and complic		2
		tocting of fue		und regist	nysis, s		and compile		2
		resuring of rus	es, grou		ance ca	alculatio	n anu uesigi	i oi pole	
	-	Analysia of d	Station	10/0.4 KV		ny (Part	$\frac{2}{2}$	ihti o.o	
	6.	networks	Istribute	ed genera	tion cor	nnection	i on the distr	IDUTION	3
	⊠ lectu	ures							
	□ sem	inars and wor	kshone		⊠ inde	ependen	t assignmen	ts	
			Konopo		⊠ mult	timedia			
Format of instruction		cises			⊠ labo	oratory			
	⊔on lir	ne in entirety				k with m	entor		
	🗆 parti	ial e-learning				(othou	-)		
		work				(other	)		
		non							
Studentresponsibiliti	- Th	e presence o	n lecture	es in the a	amount	of at lea	ast 70 % of tl	he schedu	led time.
Studentresponsibiliti	- Th - Co	e presence or mpleted all re	n lecture quired l	es in the a aboratory	amount v exerci	of at lea ses.	ast 70 % of tl	he schedu	led time.
Studentresponsibiliti es	- Th - Co - Co	e presence or mpleted all re mpleted and	n lecture quired l graded :	es in the a aboratory seminar v	amount v exerci vork as	of at lea ses. signmer	ast 70 % of tl nt.	he schedu	led time.

Screening student	Experimental work		Report		Self work		1.5
proportion of ECTS credits for	Essay		Seminar essay	1	Laboratory work		0.5
eachactivity so that	Tests	0.5	Oral exam		(Other)		
ECTS credits is equal to the ECTS value of the course)	Written exam	0.5	Project		(Other)		
Grading and evaluating student work in class and at the final exam	During the semester midterm exam will be the last week of sum given their seminar a exams and by comp and July, students c exams. Also, if the si- then he is not oblige class subject is divi- exams. Students who have a subject by taking the The last chance to p the second part of th exam students have previous results in n positive mark is that positive mark is that positive mark from s The requirement for each part of the cour entire course subject evaluated seminar a of all activities accor Grade (%) = 0,3xG1 Grade (%) = 0,6xG wherein: • G1, G2 - points obtained • S – point given for • P - presence at lec The final grade is de Grade ( 50 % do 61 62 % do 74 75 % do 87 88 % do 10 Exam terms: The first and se The discipline Under the Article 65 forms of teaching an exercises 100% of se will not be able to tal	r there e in there in the in mer ser assignm leting the an pass tudent p ed to re-i- ded into failed to e discipling ass the in- to re-take mid-term t the sture rse subject on dis ssignment ding to t + 0,3xC + 0,3xC tained for + 0,3xC + 0,3xC tained for + 0,3xC +	will be two midf eighth week of s mester. As a par ents. Student ca ier seminar assi reaming part(s) asses one part of take that part of two parts accorn pass the class of hary exam which subject is throug nn exam period. Whole exam chart has at leas assignment. The final exam ident has at leas assignment. The final scorn he formula: 62 + 0.3xS + 0.1 + 0.1xP (for disc pr each subject p disciplinary and chart subject is that the ext during midter sciplinary and chart assignment. The final scorn he formula: 62 + 0.3xS + 0.1 + 0.1xP (for disc pr each subject p disciplinary and tassignment. d as follows: Mark sufficient good(3) very good excellent( hal exam: June / commission examination.	term ex ummer t of labo n pass t gnment which t of class i the exa rding to after two is orga h comm During overing ns. In a st 50% s in stude m and f ommiss re (in per ciplinary bart durin commis (2) 4(4) 5) July m: Augu he stude st 70% of not mee	ams covering lec semester, and the pratory exercises s he class by passin s. In the two final hey didn't pass the materials through m in the second f o separation defin o final exams can nized in first part of ission exam which the disciplinary a both subject parts utumn term the r success on the ex- inal exams (or 500 ion exam), as we ercentage) is form r and commission ng midterms and (r ssion exam r and commission mg midterms and (r ssion exam) r and commission mg midterms and (r ssion exam)	ctures. T e second students ing two n l exams i hrough n first fina ied for n n try to pa of autum ch will be and comr s regardin requirem exam as 0% points ell as po hed on th n exam) (or) final a exam) (or) final	he first d one in will be nidterm in June nidterm I exam, m. The nidterm ass the n term. held in mission ng their held in mission to for the besitively e basis exams te in all oratory student
(available in the		THE			the library	other n	nedia

library and via other media)	Goić R., Jakus D., Penović I.: Distribucija električne energije - interna skripta, FESB, 2014.	e-learning
	Goić, R Upute za energetske proračune u niskonaponskoj distributivnoj mreži (2009), Split, FESB	e-learning
Optional literature (at the time of submission of study programme proposal)	<ul> <li>E. Lakaervi, E.J. Holmes: Electricity Distribution Network Design Peregrinus Lt, 1989.</li> <li>Abdelhay A. Sallam, Om P. Malik:Electric Distribution Systems, Press, 2011.</li> <li>Dale R. Patrick, Stephen W. Fardo: Electrical Distribution Syster Fairmont Press, 2009.</li> <li>E. Lakaervi, E.J. Holmes: Electricity Distribution Network Design Peregrinus Lt, 1989.</li> <li>William H. Kersting: Distribution System ModelingandAnalysis, O 2002.</li> <li>Programski paket PowerCAD, upute za rad (2009), Split, FRACT</li> <li>ProgramskipaketWINdis, upute za rad (2009), Split, FRACTAL o</li> </ul>	n, Peter Wiley-IEEE ms, The I, Peter CRC Press, TAL d.o.o. d.o.o.
Quality assurance methods that ensure the acquisition of exit competences Other (as the proposer wishes to	<ul> <li>Keeping records of student class attendance</li> <li>Annual review of the exam success</li> <li>Feedback from students via surveys</li> <li>Self-evaluation of teachers</li> <li>Feedback on the subject relevance from the former students whe graduated</li> </ul>	o have already
add)		

NAME OF THE COURSE	ELECTRICAL SAFETY							
Code	FENO15	Year of study	3.					
Course teacher	lvica Jurić-Grgić, Ph.D., Associate Professor	Credits (ECTS)	5					
Associate teachers		Type of instruction (number of hours)	L 30	S	LE 30	DE		
Status of the course	Obligatory	Percentage of application of e-learning	0					
	COURSE	E DESCRIPTION						
Course objectives	<ul> <li>Training students for:</li> <li>permanent adoption ar protective measures ag</li> <li>adoption of the method working with electrical</li> <li>testing of electrical inst</li> </ul>	nd understanding of the mo gainst electric shock, dology, procedures and mo equipment, machinery and callation	ost imp easures d plants	ortant s for pi s.	techn otecti	cal on whe	ən	
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)	<ul> <li>Students will be able to:</li> <li>explain the danger of possible electric shock on low and high voltage facilities,</li> <li>describe and define the most important technical protective measures against electric shock on low and high voltage facilities,</li> <li>examine the validity of protection against direct and indirect contact in low voltage and high voltage installations,</li> <li>examine the validity of protection against overloads and short circuits in electrical protection against overloads and short circuits in</li> </ul>							
	Course content					Lh	ours	
	Effect of electrical current on the human body.         Typesofhazardsassociatedwithelectricalcurrent:       directcontact,         indirectcontact,       transferredpotential,       inducedvoltages,       electricarc,         staticelectricity,       residualcharge,       lightningstrikes,         effectofelectricalandmagneticfieldson the human body.					,	24	
	Technicalsafetyperformanc Typesoflowvoltagesystems groundingprotectionagains simultaneousprotectionaga	eoflowvoltageinstallations , tdirectorindirectcontact, ,instdirectorindirectcontact		grou	Inding	,	6	
Course content broken down in	Protection byelectricalseparation, overvoltageprotectionfromhighvoltage system, protectionagainstatmosphericandswitchingovervoltage. Specialprotectionmeasures on constructionsitesandlimitedconductivearea.						4	
class schedule	Technicalsafetyinhighvoltag	geinstallations.					2	
(syllabus)	Overheadlines, safetydista	ncesandheights. Groundin	gotcolu	umns.			2	
	Rulesandsatetymeasures	menworking on electricalin	stallati	ons.			∠ 2	
	Safetymeasureswhenworki	ing on overheadlines.	orpiari				~	
	cablesandinundergroundfa	cilities. Live-line working.					2	
	List of laboratory exercises					LE	nours	
	Conductor continuity meas	urement					3	
	Eault loop impedance meas						ა ვ	
	Line impedance and prosp	ective short circuit current	measi	Iremer	nt		3	
	Testing of RCD Protection	Devices					3	
	Earth Resistance Measure	ment					3	
	Earth Resistivity Measuren	nent					3	

	Leakage Current Measurement						3
Format of instruction	□ lectures       □ independent assignments         □ seminars and workshops       □ multimedia         □ exercises       □ laboratory				0		
	<i>□ on line</i> in entirety <i>□</i> partial e-learning ⊠ field work			□work □ (oth	c with m ler)	entor	
Studentresponsibiliti es	Thepresence at the Performedallrequired	ectures dlaborat	at least 7 orvexerc	0% ofth ses.	netimes	scheduled.	
Screening student	Class attendance	1	Researc	h		Practical training	
work (name the proportion of ECTS	Experimental work		Report			Independent work	2,5
credits for eachactivity so that	Essay		Seminal essay	•		Laboratoryexercises	1
the total number of ECTS credits is equal to the ECTS	Tests	0,2	Oral exa	ım		Preparation for laboratoryexercises	0,2
value of the course)	Written exam	0,1	Project			(Other)	
Grading and evaluating student work in class and at the final exam	During the semester week of classes, the the entire exam by n At the two final exa midterm tests. If at curriculum that part is exam. The condition for pop part of the curriculur percent) is formed o Rating (%) = $0.1 \times L^{1}$ wherein the activity is LV -percentage obta G1, G2 - percentage curriculum given in h Students who did no last week of August this school year is a students take the en the student has at le The final score (in performula: Rating (%) = $0.1 \times L^{1}$ wherein the activity is LV -percentage obta G - percentage obta The final grade is de Rating Grade	there we second nidterm ms, stud of curric sitive as n at the n the ba $\sqrt{+0.45}$ s expres ined by ge obtai ectures. It pass the or the fin so-calle tire curr ast 50% ercentage $\sqrt{+0.9^{+1}}$ s expres ined by ined by itermine	ill be two I at the fi tests. dents tak st final e ulum the ssessmen midterm sis of all s* (G1 + ssed in p laborator ined by the exam rst week d commi iculum, a of entire te) is form * G ssed in p laborator exams of d as follo	midtern rst weel e parts xam stu studen ht is tha tests o activitie G2) ercenta of Septe ssion ex nd the o e curricu ned on t ercenta ry exerce the ent ws:	n tests. k of the udent p t does r at the st r at the es accor ge acco cises, n tests ro final e ember. kam. In condition lum. he basis ge acco	The first test will be at exam period. Student curriculum that did no asses one of the two not have to take on an udent has at least 50° final exams. The final ding to the formula: or final exams of the exams can pass the ex Last chance to take th a so-calledcommission n for positive assessm s of all activities accord ording to: iculum given in lecture	the eighth can pass by parts of other final % of each grade (in % parts of am at the e exam in h exam all ent is that ding to the es.

	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	Title	Number of copies in the library	Availability via other media
media)	I. Jurić-Grgić: Lectures, FESB		e-learning portal
Optional literature (at the time of submission of study programme proposal)	E. Mileusnić: Ispitivanjeelektričnihinstalacijaniskogna Siemens: ElectricalInstalationHandbook-Third Editior John&Wiley, 2000.	pona, ZIRS, Z n,(Editor: Gunt	agreb, 2006. er G Seip)
Qualityassuranceme	- Evaluation of students presence on lectures		
thodsthatensurethea	<ul> <li>Evaluation of results in accordance with the above</li> </ul>	e learning out	comes
cquisitionofexitcomp	<ul> <li>Feedback from students via surveys</li> </ul>		
etences	- Self-evaluation of teachers		
	- Institutional and non-institutional evaluations		
Other (as the			
add)			

NAME OF THE COURSE	ELECTRONIC CONVERTERS FOR POWER SUPPLIES								
Code	FENO21	Year of study	3						
Course teacher	Dinko Vukadinović, Ph.D., Full Professor	Credits (ECTS)	5						
Associate teachers	Mateo Bašić, Ph.D. Assistant Professor Ivan Grgić, Assistant	Type of instruction (number of hours)	L 30	S 0	AE 15	LE 15	DE 0		
Status of the course	Obligatory	Percentage of application of e-learning	Percentage of						
	COURS	E DESCRIPTION							
Course objectives	Training students for: - understanding of basic pr - making a selection of con	inciples of electronic conv	erters f	or pow s for po	er sup	plies Ipplies			
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)	<ol> <li>Explain the operating primode</li> <li>Describe the characteris</li> <li>Analyze single-phase haresistor</li> <li>Analyze the impact of the commutation in the single-p</li> <li>Calculate the minimal in operation in continuous mode</li> <li>Discuss the current and</li> <li>Derive the voltage transis</li> <li>Explain the active power</li> <li>Comparethe UPS system energy mode of operational</li> </ol>	<ol> <li>Explain the operating principles of electronic converters in the linear and switch node</li> <li>Describe the characteristics of electronic converters components</li> <li>Analyze single-phase half-wave diode rectifier loaded with the capacitor and the esistor</li> <li>Analyze the impact of the power transformer leakage inductance on the natural commutation in the single-phase bridge rectifier</li> <li>Calculate the minimal inductance in the DC-DC converters which ensures the operation in continuous mode</li> <li>Discuss the current and voltage waveforms in isolated DC-DC converters</li> <li>Derive the voltage transfer ratio for isolated DC-DC converters</li> <li>Explain the active power factor correction</li> <li>Comparethe UPS systemswhichoperateinnormal mode of operation, instored-</li> </ol>							
	Course content				L hours	h	AE ours		
	Introduction. Schemes of e	lectronicconverters for			1				
	Components of electronicc	onverters for powersupplie	25		1				
	Diode rectifiers				3		3		
	Switch-mode non-isolated buck-boost, Ćuk and bridge	DC-DC converters (buck, l e)	boost,		3		4		
Course content	Switch-mode isolated DC-I push-pull, half-bridge and t	DC converters (forward, fly pridge)	/back,		6		4		
broken down in detail by weekly	Single-phase and three-ph	ase inverters			4		3		
class schedule	Frequency converters				2				
(syllabus)	Active and passive power f	actor correction			2		1		
( <b>,</b> )	Uninterruptable power sup	ply			2				
	Examples of electronic con electric power generation	verters in electric drives a	nd		2				
	List of laboratory exercises					h	LE ours		
	Single-phase half-wave dio	de rectifier					4		
	Single-phase full-wave diod	le rectifier					4		
	Non-isolated DC-DC boost	converter					4		
Non-isolated DC-DC buck-boost converter							3		

	Speed control system of a separately-excited DC motor 3							3
	x lectures							
	□ seminars and workshops				ent a	ssignments		
Format of instruction	⊠ exercises							
Format of Instruction	□ <i>on line</i> in entirety				y n m o r	tor		
	□ partial e-learning				mer	1101		
	☐ field work							
Studentresponsibiliti es	The presence on lect Performed all require	tures in d labora	the amo atory exe	unt of at leas ercises.	st 70	% of the time	s schedule	d.
Screening student work (name the	Class attendance	1	Resear	ch	Practical training		ining	
proportion of ECTS credits for	Experimental work		Report			Individual wo	ork	2
eachactivity so that	Essay		Semina	r essay		Laboratory e	exercises	1
ECTS credits is	Midterm exams	0.3	Oral exa	am		Auditory exe	ercises	0.5
value of the course)	Written exam	0.2	Project			(Other)		
	During the semester, and the second after either theoretical or course which they did	, two mi 13 weel numeric d not pa	dterm ex ks of lect cal. In th iss in the	kams are hel ures. Each n e final exam midterm exa	ld - th nidter ns, st ams.	ne first after 7 rm exam cons tudents take	' weeks of I sists of 4 pro those parts	ectures oblems, s of the
	The requirement for passing grade is that the sum of the laboratory exercises' grade (L) and the midterms' grades (M1 and M2), expressed as a percentage, is 50% of more. The sum is calculated as							s' grade 50% or
	Grade (%) = 0.25L + 0.375(M1 + M2)							
	where the number of points achieved in each midterm exam has to be at least 50%.							
Grading and evaluating student work in class and at the final exam	The students that do not pass the midterm exams take the final written exam which consists of 4 problems. The requirement for a positive evaluation of the final exam is at least 50% points achieved. In the final exam, the students that did not pass one of the midterm exams are presented with 4 problems from the corresponding part of the course. Subsequently, the grade is determined as follows:							
	Grade (%) = 0.25L + 0.75(I)							
	where I is the number of points achieved in the final written exam (at least 50%).							
	The final grade for the course is determined as follows:							
	50% to 61% - Suffici 62% to 74% - Good 75% to 87% - Very g 88% 100% - Exceller	ient (2) (3) good (4) nt (5)						
Deguing d literation						Number of	Availabil	ity via
Required literature		Title				copies in	other m	edia
library and via other	· · · · ·	<u> </u>				the library		
media)	Vukadinović, D.: Pred pretvarači za napajar	davanja nje, šk. g	iz koleg god. 201	ija Elektronič 4/15.	čki		e-learning	portal
Optional literature	Hase, Y · Handbook	of powe	er system	ns engineerir	na wit	h power elec	tronics	
(at the time of submission of study programme proposal)	applications, John W Emadi A., Nasiri A., E CRC Press, New Yor	iley, 20 Bekiarov rk, 2005	13. / S. B.: L	Ininterruptab	ble Po	ower Supplies	sandActive	Filters,
	- Keeping records	of stude	ent atten	dance				
methods that ensure	- Annual analysis	of the pe	erforman	ice at midter	m exa	ams and final	exams	

the acquisition of exit competences	<ul> <li>Feedback from students via surveys</li> <li>Self-evaluation of teachers</li> <li>Feedback from graduated students</li> </ul>
Other (as the proposer wishes to add)	

NAME OF THE COURSE	RENEWABLE ENERGY S	RENEWABLE ENERGY SOURCES							
Code	FENO29	Year of study	3						
Course teacher	Damir Jakus, Ph.D. Assistant Professor	Credits (ECTS)	5						
Associate teachers	Josip Vasilj, Ph.D.	Type of instruction (number of hours)	L 30	S 0	AE 0	LE 30	DE		
Status of the course	Elective	Percentage of application of e-learning	30						
	COURSE	DESCRIPTION							
Course objectives	<ul> <li>Training students for:</li> <li>Understanding the operating characte financing options</li> <li>Implementation of RES</li> <li>Assessment of the op RES</li> <li>Analysis of networl</li> <li>Project economic f</li> </ul>	specifics related to the wo ristics of renewable energ a legislative framework that annual energy potential for timal parameters and proj k conditions after connecti easibility assessment for o	orking p y source at prom or varice ect solu on of R differen	orincip ces as notes ous ty utions RES t RES	ples a s well produ pes of s for d	nd as proj ction fi RES ifferent	iect rom		
Course enrolment requirements and entry competences required for the course	None Students will be able to: - Define different RES te	echnologies, explain their r	nethod	ls of c	operat	ion and	d list		
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	<ul> <li>main system compone</li> <li>Explain and critically an RES</li> <li>Estimate the annual eleplants</li> <li>Perform project profital</li> <li>Define the basic technic connecting to the power</li> <li>Conduct the RES grid of Explain the impact of R development, planning</li> <li>Select the parameters</li> </ul>	<ul> <li>Define different RES technologies, explain their methods of operation and lis main system components for different RES plants</li> <li>Explain and critically analyze different financial promotion mechanisms for RES</li> <li>Estimate the annual electricity production for certain types of RES power plants</li> <li>Perform project profitability assessments for certain types of RES</li> <li>Define the basic technical requirements which need to be met by RES when connecting to the power system</li> <li>Conduct the RES grid connection analysis and elaborate gird impacts</li> <li>Explain the impact of RES large scale integration on power system development, planning, operation and management</li> </ul>							

	Course content	L or S	AE hours	
	1 RENEWABLE ENERGY SOURCES INTRODUCTION	liouio	nouro	 Γ
	The need for renewable energy sources			 +
	The main sources and forms of energy	2		 +
	Properties of renewable energy sources	_		 +
	The current status of renewable energy			 +
	2 RES REGULATION FRAMEWORK	+		 +
	The FU directive on RES	3		
	Renewable energy sources in the Croatian law	5		
	3 WIND POWER PLANTS	+		 +
	The wind power and energy			 +
	WPP types and mains components			 +
	The working principle of WPP	4		 +
	WPP grid connection requirements			 +
	The WPP market and the situation in Croatia			 +
	4 SOLAR POWER PLANTS	+		 +
	Calculation of solar radiation			
	Solar power plants working principles and main parts	4		
	PV power plant electricity production			
	Grid connected and standalone systems			
	5 SOLAR THERMAL POWER PLANTS	1		
	6 IMPACT OF WIND AND PV POWER PLANTS ON	2		
Course content	POWER SYSTEM OPERATION AND MANAGEMENT	5		 
broken down in detail by weekly	7 HYDRO POWER PLANTS			 L
class schedule	Hydropower resources			 L
(syllabus)	Hydro power and energy	4		 .L
	The basic components, their roles, performance and			
	operating principles			 
	Turbines and generators for small HPP			 
	8 BIOMASS ENERGY			
	Types and basic characteristics of biomass			
	The different technologies for utilization of biomass	3		
	I he potentials and biomass production			
	Different principles of biomass conversion into solid			
		+		 +
	9 GEOTHERMAL ENERGY			 +
	Conthermal resources	2		 +
	Direct use of goothermal energy for heating	3		 +
	The use of geothermal energy for fleating			 +
		+		 +
	10 OTHER TYPES OF RES			
	Tidel neuror	3		
	Deepen thermal energy converters			
	Ocean thermal energy converters			
	List of laboratory or design exercises		hours	
	1. Technical visit to roof mounted PV power plant		4	
	2. Technical visit to wind power plant		6	
	3. Introduction to software package Homer		4	

4. Project assignment regarding standalone and grid connected							4	
5 Project assig	<u>in and p</u> nment r	egarding	solar c	ollector	system design and			
profitability a	analysis	egurung	50101 0	onector	system design and		4	
6. Techno-ecor	nomic ar	alysis of	investm	nent in F	V power plant		4	
7. Analysis of R	ES conn	ection im	pacts o	n powe	r losses and		4	
voltage profi	voltage profile change in the MV distribution network						4	
⊠ lectures	I lectures							
□ seminars and workshops			independent assignments					
□ exercises ⊠ multimedia								
□ partial e-learning	$\Box$ partial e-learning $\Box$ work with mentor							
⊠ field work								
- The presence or	n lecture	es in the a	amount	of at lea	ast 70 % of the sched	dule	ed	
time.		oborotori	, ovoroj					
<ul> <li>Completed and</li> <li>Completed and</li> </ul>	positivel	lv graded	semina	ses. ar assia	nment.			
Class attendance	1	Researc	:h		Practical training			
Experimental work		Report		1	Self work		1.5	
Essay		Seminai essay	•		Laboratory work		0.5	
Tests	0.5	Oral exam		(Other)				
Written exam	0.5	Project			(Other)			
During the semester midterm exam will be in the last week of s will be given their wo can pass the class laboratory work ass students can pass re Also, if the student p he is not obliged to class subject is divid exams.	r there v e in the summer ork assig s by pa signmen eaming p asses o re-take ded into	vill be two eighth we semeste proments we ssing two ts. In the part(s) wh ne part o that part two parts	o midte eek of s r. As a vhich w o midte e two f nich the f class r c of the s accord	rm exar part of ill be gra erm exa inal exa y didn't material exam i ding to s	ns covering lectures. semester, and the se laboratory exercises aded after completion ams and by comple ams in February an pass through midtern s through first final es n the second final es separation defined fo	. The stunction of the string d Normed carr m e carr m r m m	ne first nd one udents tudent tudent g their March, exams. n, then n. The idterm	
Students who have failed to pass the class after two final exams can try to p subject by taking the disciplinary exam which is organized in first part of term. The last chance to pass the subject is through commission exam w be held in the second part of the autumn exam period. During the disciplin commission exam students have to re-take whole exam covering both subjec regarding their previous results in mid-term and final exams. In autumn the requirement for positive mark is that the student has at least 50% success exam as well as positive mark from seminar assignment. The requirement for positive mark is that the student has at least 50% point each part of the course subject during midterm and final exams (or 50% point each part of the course subject on disciplinary and commission exam), as positively evaluated seminar assignment. The final score (in percentage) is on the basis of all activities according to the formula: Grade (%) = 0,35Xg1 + 0,35Xg2 + 0,3Xs Grade (%) = 0,7Xg + 0,3Xs (for disciplinary and commission exam)					o pa of a whi ina jjec ter ss point s w is f	iss the utumn ch will ry and t parts rm the on the s from nts for vell as ormed		
	<ul> <li>4. Project assig system desig</li> <li>5. Project assig profitability a</li> <li>6. Techno-ecor</li> <li>7. Analysis of R voltage profit</li> <li>⊠ lectures</li> <li>□ seminars and wor</li> <li>□ exercises</li> <li>□ on line in entirety</li> <li>□ partial e-learning</li> <li>⊠ field work</li> <li>Completed all reference of time.</li> <li>Completed all reference</li> <li>Completed and</li> <li>Class attendance</li> <li>Experimental work</li> <li>Essay</li> <li>Tests</li> <li>Written exam</li> <li>During the semeste midterm exam will be in the last week of s will be given their wor can pass the class laboratory work ass students can pass reference of class subject is divident positively evaluated be held in the second commission exam strest regarding their previous dividents of subject by taking the term. The last chance</li> <li>Students who have fisubject by taking the term. The last chance</li> <li>Students who have fisubject by taking the term. The last chance</li> <li>Grade (%) = 0,35Xg Grade (%) = 0,7Xg</li> <li>wherein:</li> </ul>	<ul> <li>4. Project assignment r system design and p</li> <li>5. Project assignment r profitability analysis</li> <li>6. Techno-economic ar</li> <li>7. Analysis of RES conn voltage profile change</li> <li>Seminars and workshops</li> <li>exercises</li> <li>on line in entirety</li> <li>partial e-learning</li> <li>field work</li> <li>Completed all required I</li> <li>Completed and positive</li> <li>Class attendance 1</li> <li>Experimental work</li> <li>Essay</li> <li>Tests 0.5</li> <li>Written exam will be in the in the last week of summer will be given their work assig can pass the class by pa laboratory work assignmen students can pass reaming p</li> <li>Also, if the student passes of he is not obliged to re-take class subject is divided into exams.</li> <li>Students who have failed to subject by taking the discipiterm. The last chance to pa be held in the second part of commission exam students I regarding their previous residered into exams.</li> <li>Students who have failed to subject by taking the discipiterm. The last chance to pa be held in the second part of commission exam students I regarding their previous residered into exam as well as positive material exam as well as positive material exam as well as positive material exam as well as positive material examples and so fall activities and the requirement for positive material exam as well as positive material examples and so fall activities and positively evaluated semination on the basis of all activities and the requirement for positive material examples and and activities and the requirement for positive material examples and so fall activities and the requirement for positive material examples and activities and the positi</li></ul>	<ul> <li>4. Project assignment regarding system design and profitabili</li> <li>5. Project assignment regarding profitability analysis</li> <li>6. Techno-economic analysis of</li> <li>7. Analysis of RES connection im voltage profile change in the</li> <li>I lectures</li> <li>I seminars and workshops</li> <li>I exercises</li> <li>I on line in entirety</li> <li>I partial e-learning</li> <li>I field work</li> <li>Completed all required laboratory</li> <li>Completed and positively graded</li> <li>Class attendance</li> <li>Report</li> <li>Essay</li> <li>Tests</li> <li>O.5</li> <li>Oral examples</li> <li>Written exam</li> <li>O.5</li> <li>Project</li> <li>During the semester there will be two midterm exam will be in the eighth we in the last week of summer semeste will be given their work assignments. In the students can pass reaming part(s) wh Also, if the student passes one part o he is not obliged to re-take that part class subject is divided into two parts exams.</li> <li>Students who have failed to pass the subject by taking the disciplinary exaterm. The last chance to pass the subject or regarding their previous results in micquirement for positive mark is that exam as well as positive mark is that example positively evaluated seminar assignment is positively evaluated seminar assignment is the requirement for positive mark is that exam as well as positive mark is that example positively evaluated seminar assignment is that example positively evaluated seminar assignment is that example positively evaluated seminar assignment is the example positively evaluated seminar assignment is that example positive positis positive positive positiv</li></ul>	<ul> <li>4. Project assignment regarding standa system design and profitability calcutors</li> <li>5. Project assignment regarding solar comprofitability analysis</li> <li>6. Techno-economic analysis of investm</li> <li>7. Analysis of RES connection impacts or voltage profile change in the MV dist</li> <li>I ectures</li> <li>I seminars and workshops</li> <li>I and indexersions</li> <li>I an</li></ul>	<ul> <li>4. Project assignment regarding standalone an system design and profitability calculation</li> <li>5. Project assignment regarding solar collector profitability analysis</li> <li>6. Techno-economic analysis of investment in F</li> <li>7. Analysis of RES connection impacts on powe voltage profile change in the MV distribution</li> <li>I lectures</li> <li>seminars and workshops</li> <li>independen</li> <li>exercises</li> <li>multimedia</li> <li>laboratory</li> <li>partial e-learning</li> <li>vork with m</li> <li>field work</li> <li>and positively graded seminar assig</li> <li>Class attendance</li> <li>Research</li> <li>Experimental work</li> <li>Report</li> <li>Essay</li> <li>Seminar essay</li> <li>Tests</li> <li>0.5</li> <li>Oral exam</li> <li>Written exam will be in the eighth week of summer in the last week of summer semester. As a part of will be given their work assignments. In the two final exat assignments which will be gracian pass the class by passing two midterm exat assignments. In the two final exat subject is divided into two parts according to sexams.</li> <li>Students who have failed to pass the class after two subject by taking the disciplinary exam which is org term. The last chance to pass the subject is through be had in the student passes one part of class material he is not obliged to re-take that part of the exam is class subject is divided into two parts according to sexams.</li> <li>Students who have failed to pass the class after two subject by taking the disciplinary exam which is org term. The last chance to pass the subject is through be had in the second part of the autumn exam peric commission exam students have to re-take whole ex regarding their previous results in mid-term and fin requirement for positive mark is that the student has exam as well as positive mark is that the student has exam as well as positive mark is that the student has exam as well as positive mark is that the student has exam as on the bass of all activities according to so positively evaluated semi</li></ul>	4. Project assignment regarding standalone and grid connected system design and profitability calculation         5. Project assignment regarding solar collector system design and profitability analysis         6. Techno-economic analysis of investment in PV power plant         7. Analysis of RES connection impacts on power losses and voltage profile change in the MV distribution network         ☑ lectures         ☑ seminars and workshops       ☑ independent assignments         ☑ services       ☑ multimedia         ☑ on line in entirety       ☑ laboratory         □ partial e-learning       ☑ work with mentor         ☑ field work       □ completed all required laboratory exercises.         - Completed all required laboratory exercises.       - Completed and positively graded seminar assignment.         Class attendance       1       Research       Practical training         Experimental work       Report       1       Self work         Written exam       0.5       Project       (Other)         Written exam       0.5       Project       (Other)         During the semester there will be two midterm exams in February an students can pass reaming part(s) which they didn't pass through midter Also, if the student passes one part of class materials through first final evans on class subject is divided into two parts according to separation defined for exams.         Students who have failed to pass the class after two f	4. Project assignment regarding standalone and grid connected system design and profitability analysis         5. Project assignment regarding solar collector system design and profitability analysis         6. Techno-economic analysis of investment in PV power plant         7. Analysis of RES connection impacts on power losses and voltage profile change in the MV distribution network         ⊠ lectures         □ seminars and workshops       ☑ independent assignments         □ carcises       ☑ multimedia         □ on line in entirety       ☑ laboratory         □ partial e-learning       ☑ work with mentor         2 field work       ☑ laboratory         - The presence on lectures in the amount of at least 70 % of the schedule time.       Completed all required laboratory exercises.         - Completed and positively graded seminar assignment.       Class attendance         Class attendance       1       Research       Practical training         Experimental work       Report       1       Self work         Essay       Seminar essay       Laboratory work         Tests       0.5       Project       (Other)         Written exam       0.5       Project       Sectory and I storatory exercises stimiter mexam will be in the eight week of summer semester, and the second in the sat week of summer semester. As a part of laboratory exercises stin the istory exercises stimiter mexam will be in the e	

	<ul> <li>G1, G2 – points obtained for each subject part of exams</li> <li>G – points obtained during disciplinary and commis</li> <li>S – point given for seminar assignment</li> </ul>	31, G2 – points obtained for each subject part during midterms and(or) final ams G – points obtained during disciplinary and commission exam G – point given for seminar assignment							
	The final grade is determined as follows:           Grade (%)         Mark           50 % do 61%         sufficient (2)           62 % do 74 %         good(3)           75 % do 87 %         very good(4)           88 % do 100 %         excellent(5)								
	Exam terms: The first and second final exam: February / Mar The disciplinary and commission exam: August	ch / September							
	Under the Article 65 of the Faculty Statute, the student is required to participate in all forms of teaching and attend: lectures at least 70% of scheduled time and laboratory exercises 100% of scheduled time. If you do not meet these requirements the student will not be able to take the examination								
	Title	Number of copies in the library	Availability via other media						
Required literature	Jakus, D.: Obnovljivi izvori energije, skripta + slajdovi s predavanja + dodatni materijali		e-learning						
(available in the library and via other media)	Jakus, D., Krstulović Opara, J. : Obnovljivi izvori energije – upute za laboratorijske vježbe -, Split 2013.		e-learning						
	Šljivac, D., Šimić, Z.: Obnovljivi izvori energije s osvrtom na uštede, udžbenik, ETF Osijek, 2008.								
	Rajkovič, D.: Proizvodnja i pretvorba energije, Rudarsko-geološko-naftni fakultet, Zagreb, 2011								
Optional literature (at the time of submission of study programme proposal)	<ul> <li>L. Freris, D.Infield: Renewable Energy in Power S</li> <li>T. Ackerman: Wind Power in Power Systems, Wi</li> <li>J. Twidell, T. Weir: Renewable Energy Resources</li> </ul>	Systems, Wile iley, 2012. s, Taylor ✔ Fi	ey, 2008 rancis, 2005.						
Quality assurance methods that ensure the acquisition of exit competences	<ul> <li>Keeping records of student class attendance</li> <li>Annual review of the exam success</li> <li>Feedback from students via surveys</li> <li>Self-evaluation of teachers</li> <li>Feedback on the subject relevance from the form already graduated</li> </ul>	ner students w	/ho have						
Other (as the proposer wishes to add)									

NAME OF THE COURSE	POWER SYSTEM AND ENVIRONMENT								
Code	FENO22	Year of study	3.						
Course teacher	Tonći Modrić, Ph.D., Assistant Professor Mate Dabro, Ph.D., Assistant Professor	Credits (ECTS)	5						
		Type of instruction	L S AE	LE DE					
Associate teachers		(number of hours)	30 0 0	30 0					
Status of the course	Elective	Percentage of application of e-learning	0						
	COURSE	E DESCRIPTION							
Course objectives	<ul> <li>Training students for under</li> <li>characteristics of the p</li> <li>various aspects of the environment,</li> <li>environmental protection</li> </ul>	standing and application s ower system in the Repub impact of electric power fa on from the effects of power	specialized knowl lic of Croatia, icilities, plants an er facilities, plants	edge of: I lines on the and lines.					
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)	<ul> <li>Students will be able to:</li> <li>describe the characteri</li> <li>describe the various as and lines on the enviro</li> <li>specify the reference le</li> <li>measure the power fre</li> <li>explain the principle of</li> <li>explain the principle of potential,</li> <li>measure resistivity of s geoelectric sounding d</li> <li>describe the protective facilities, plants and lin</li> <li>explain the basic princi the environment of eler</li> </ul>	<ul> <li>Students will be able to:</li> <li>describe the characteristics of the power system in the Republic of Croatia,</li> <li>describe the various aspects of the impact of electric power facilities, plants and lines on the environment,</li> <li>specify the reference levels of powerfrequency electric and magnetic fields,</li> <li>measure the power frequency magnetic flux density and electric field intensity,</li> <li>explain the principle of measuring ground resistance of the grounding system,</li> <li>explain the principle of measuring touch voltage, step voltage and transferred potential,</li> <li>measure resistivity of soil and explain the principle of interpretation of geoelectric sounding data,</li> <li>describe the protective measures against harmful effects of electric power facilities, plants and lines on the environment,</li> <li>explain the occurrence of electrical corrosion and the basic principles of protection against electrical corrosion,</li> <li>explain the basic principles of fire protection and poise levels measurements in</li> </ul>							
	Course content Power system in the Repul Electricity generation. Electric power transmission	blic of Croatia. n and distribution.		L hours 2 4 4					
Course content	Electric power consumption Calculation of powerfreque plants.	n. ncy electromagnetic fields	of power lines a	2 Id 4					
detail by weekly class schedule (svllabus)	Measurement of powerfree and plants. Prescribed refe levelsofpowerfrequencyele	uency electromagnetic fie erence ctricandmagneticfields.	lds of power lines	2					
(0)10000)	The impact of the power sy	stem on the environment.		4					
	Fire and noise protection.	ndoutoidothoolootrio novvo	r plante	2					
	List of laboratory exercises		r plants.						
	Calculation of nowerfrequen	cymagneticfluxdensity							
	Measurement of powerfrequent	uency magneticfluxdensity		3					
	Calculation of powerfrequen	cyelectricfieldintensity.		3					

	Measurement of pow	/erfrequ	ency elec	tricfieldintensit	<i>y</i> .		3	
	Geoelectric sounding	Geoelectric sounding.						
	Interpretation of geoe	electric s	sounding	data.			3	
	Ground resistance m	easurer	ment of a	small groundin	g system.		3	
	Checking the system	Checking the system of the fire protection.					3	
	Noise measurement	in the e	nvironme	nt of electricpo	wer plant.		3	
				⊠ independer	t assignments			
	□ seminars and wo	rksnops		□ multimedia	U U			
Format of instruction				⊠ laboratory				
				□ work with m	nentor			
				□ (other)				
01 1 2 2			4				11	
responsibilities	Performed all require	ed labor	the amo	ercises.	0% of the times	s schedu	led.	
Screening student work (name the	Class attendance	2,0	Researc	h	Practical trainir	ng		
proportion of ECTS	Experimental work		Report		Individual work	ζ.	1,7	
activity so that the	Essay		Seminai essay		Laboratory exe	ercises	0,8	
total number of ECTS credits is	Tests	0,2	Oral exa	ım	Preparation for	rcises	0,2	
equal to the ECTS value of the course)	Written exam	0,1	Project		(Other)	0000		
Grading and evaluating student work in class and at the final exam	Inere are two midte lecturing and the set of 10 theoretical que final exams students and final exams are is the positive asses exam or the final exa the activities in perce LV - laborat G1, G2 - mi In a case of final exa the activities in perce LV - laborat G - final tes Thefinal grade isdete 50 - 61 % s 62 - 74 % g 75 - 87 % v 88 - 100 %	There are two midterms and final exams. The first midterm exam is after 7 week ecturing and the second one is after the next 6 weeks. Each midterm test cons of 10 theoretical questions while final tests consist of 20 theoretical questions. In inal exams students that did not pass the midterm exams take part. The midte and final exams are carried out as written tests. The requirement for passing gra- s the positive assessment of laboratory exercises and 50 % points on each midte exam or the final exam. Grade (in percentage) is formed according to the formula Grade (%) = 0,1 LV + 0,45 (G1 + G2) the activities in percentage: • LV – laboratory assessment, • G1, G2 – midterm test results. n a case of final exams, grade (in percentage) is formed according to the formula Grade (%) = 0,1 LV + 0,9 G the activities in percentage: • LV – laboratory assessment, • G – final test result. Thefinal grade isdetermined as follows: • $50 - 61$ % sufficient (2) • $62 - 74$ % good (3)					ormula:	
		Title	9		Number of copies in the library	Availab other	ility via media	
Required literature (available in the library and via other media)	T. Modrić, M. Dabro Elektroenergetski su u Splitu, FESB, Split (interna skripta u ele D. Feretić i dr.: "Elek Zagreb, 2000.	: "Preda istav i ol :, 2017. ektroničk ktrane i o	ivanja iz p koliš (511 kom oblik okoliš", E	oredmeta )", Sveučilište u) lement,	5	e-lea po	rning rtal	
	B. Udovičić: "Elektro Zagreb, 2005.	10						

Optional literature (at the time of submission of study programme proposal)	<ul> <li>CIGRETechnicalBrochure 535, "EMC within Power Plants and Substations", 2013.</li> <li>CIGRE Technical Brochure 592, "Guide for Assessment of Transferred EPR on Telecommunication Systems due to Faults in A.C. Power Systems", 2014.</li> <li>CIGRE Technical Brochure 95, "Guide on the Influence of High Voltage A.C. Power Systems on Metallic Pipelines", 1995.</li> <li>CIGRE TechnicalBrochure 290, "AC Corrosion on MetallicPipelinesdue to Interferencefrom AC Power Lines –Phenomenon, ModellingandCountermeasures", 2006.</li> </ul>
Quality assurance methods that ensure the acquisition of exit competences	<ul> <li>Evaluation of student presence on lectures</li> <li>Evaluation of results in accordance with the above learning outcomes</li> <li>Feedback from students via surveys</li> <li>Self-evaluation of teachers</li> <li>Institutionalandnon-institutionalevaluations</li> </ul>
Other (as the proposer wishes to add)	-

NAME OF THE COURSE	BIOMECHANICS PRACTICUM						
Code	FELO44	Year of study	3.				
Course teacher	Josip Musić, Ph.D., Assistant Professor	Credits (ECTS)	5				
Associate teachers	Tea Marasović, PhD	Type of instruction (number of hours)	L 15	S 0	AE 0	LE 45	DE 0
Status of the course	Elective	Percentage of application of e-learning	0				
	COURSE	E DESCRIPTION					
Course objectives	<ul> <li>Training students for:</li> <li>understanding basic pr</li> <li>application of acquired with emphasis on used</li> </ul>	inciples and terminology in knowledge on design and I measurement equipment	n the a I condu	rea of I iction c	biome of expe	chanic erimen	cs. Its
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)	<ul> <li>Students will be able to:</li> <li>recognize technical systems used in biomechanical measurements.</li> <li>calculate human anthropometric parameters.</li> <li>apply appropriate measurement equipment for human gait measurements, as well as ground reaction forces, EMG and range of movement measurements.</li> <li>analyze human gait kinematics.</li> <li>calculate forces and moments in human joints using inverse kinematics.</li> <li>illustrate application of computer vision in biomechanics</li> </ul>						, as nts.
	Course content						
	Introduction to biomechanics; Overview of technical systems for measurement of human biomechanical parameters.						1
	Measurement methods and	d procedures in biomechar	nics.				1
	Human anthropometric par	ameter identification.					1
	Gait analysis: terminology and measurements. Human gait parameter measurements; Kinematics and Kinetics.						2
	Position and balance of hu	man body during the gait.					1
	Ground reaction forces dur	ing the gait.					1
	Electromyography, measur	ing muscle activity during	humar	move	ment.		3
Course content	Inverse kinematics for iden	tification of muscle activity	'.				2
broken down in	Application of computer vis	ion in biomechanics.					1
detail by weekly class schedule	List of laboratory or design	exercises				LE o ho	or DE ours
(syllabus)	Introductory lecture on labo	ratory protocols, available	measu	iremer	nt		4
	equipment as well as tasks Measurement of human ant	during laboratory exercise	IS. ia finita		ant		
	method.			elenie	ent		5
	Measurement of human gai	t parameters via tast came	eras.	roo pla	oto		6
	Measurement of EMC size	action forces during the ga	it via iC	nce pla	aເບ.	+	0 6
	Estimation of muscle activity	v and joint moments during	a huma	an aait	hased		0
	on measured kinematic par	ameters and around react	ion for	Ces:	54556		6
	comparison with measured	imparison with measured EMG signals.					
	Measurement of range of munits.	notion of cervical spine via	inertial	senso	or		6
	Application of computer visi of Croatia sign language.	on for classification and a	utomat	ic trans	slation		6

Format of instruction	<ul> <li>☑ lectures</li> <li>□ seminars and workshops</li> <li>☑ exercises</li> <li>□ on line in entirety</li> <li>□ partial e-learning</li> <li>□ field work</li> <li>□ independent</li> <li>☑ multimedia</li> <li>☑ multimedia</li> <li>☑ work with m</li> <li>□ (other</li> </ul>			t assignments ientor r)				
Studentresponsibiliti es	The presence on lect Performed all require	tures in ed labor	the amo atory exe	unt of at crcises.	least 7	0 % of the time	s schedul	led.
Screening student	Class attendance	0,5	Researc	:h		Practical training	ng	
proportion of ECTS	Experimental work		Report			Individual work	(	2
eachactivity so that	Essay		Seminai essay	•		Laboratory exe	ercises	2
the total number of ECTS credits is equal to the ECTS	Tests	0,1	Oral exa	ım		Preparation for laboratory exe	r rcises	0,3
value of the course)	Written exam	0,1	Project			(Other)		
Grading and evaluating student work in class and at the final exam	During the semester weeks of lectures ar test (as well as the minutes. It consists of exams students that consists of 6 theore passing grade is the average midterm exa at least 40% of tota average is at least 5 Grade (in percentag Grade(%) = 0,5L + 0 where: • L – laborator • M1, M2 – mi Final grade (based of Percentage G 50% do 62% suf 63% do 74% goo 75% do 86% ver 87% do 100% exo According to Article teaching activities a exercises. In accord grading 100% of all I or he won't be able to course the next year	ring the semester there are two midterm exams. The first midterm exam is seks of lectures and the second one is after 13 weeks of lectures. Each m st (as well as the final test) is carried out in a written format with duration nutes. It consists of both theoretical questions and numerical problems. In th ams students that did not pass the midterm exams take part. The final exa nsists of 6 theoretical questions and numerical problems. The requirem ssing grade is the positive assessment of laboratory exercises and 50 % pc erage midterm exam ((M1 + M2)/2) or the final exam. Students are allowed the least 40% of total points on each midterm exams, as long as the final m erage is at least 50% of total points. "ade (in percentage) is formed according to the formula: "ade(%) = 0,5L + 0,5(M1 + M2) here: L – laboratory assessment, M1, M2 – midterm test results. hal grade (based on percentages) is formed as follows: ercentage Grade % do 62% sufficient (2) % do 74% good (3) % do 86% very good (4) % do 100% excellent (5) ccording to Article 65. of Faculty's Bylaw, student is required to participat aching activities attending at least 70% of lectures, and 100% of lab ercises. In accordance with that student is required to solve and turn of ading 100% of all laboratory exercises. If student does more these criter						te in all poratory pover for ria, she il in the
		Title	•			copies in the library	Availabi other n	lity via nedia
Required literature (available in the library and via other media)	Winter D.A.: The Bic of Human Gait, Univ Waterloo, 1991.	mechar ersity of	nics and I f Waterlo	Motor Co o Press,	ontrol		teach	her
	V. Zanchi, J. Musić: script, FESB, 2005.	Biomeh	anika I di	o, intern	nal		teach	her

	V. Zanchi, V. Papić, T. Šupuk: Biomehanika II dio, internal script, FESB, 2005.		teacher			
	T. Marasović, Guidelines for laboratory exercises, FESB		e-learning portal			
	J. Musić: Authorized lecture notes, FESB		é-learning portal			
Optional literature (at the time of submission of study programme proposal)	. J. Perry: Gait Analysis: Normal and Pathological Function, Slack Inc. 1992 . R. J. Jagacinski, J. M. Flach: Control Theory for Humans: Quantitative pproaches to Modeling Performance, Lawrence Erlbaum Associates Inc., 2003 . Zanchi V., Cecić M., Grujić T., Kuzmanić A., Papić V. : Laboratory for dentification of Human Movement with LaBACS Software Support, International Congress on Computational Bioengineering, ICCB'03, 24-26 September 2003., Crangeza, Spain, p. p. 155, 161					
Quality assurance methods that ensure the acquisition of exit competences	<ul> <li>Keeping records of student attendance.</li> <li>Annual analysis of course statistics in terms of midterm and finals exams</li> <li>Feedback from students via surveys.</li> <li>Feedback from graduated students (or senior students) on course content relevance.</li> <li>Self-evaluation of teachers.</li> <li>Periodic institutional evolution of course teachers</li> </ul>					
Other (as the proposer wishes to add)	/					

NAME OF THE COURSE	ELECTROMAGNETIC COMPATIBILITY								
Code	FELO21	Year of study	3.						
Course teacher	Vicko Dorić, Ph.D., Associate Professor	Credits (ECTS)	5						
Associate teachers	Sociate teachers Maia Škilio, Ph D. Type of instruction		L	S	AE	LE	DE		
	iviaja Skiijo, Fli.D.	(number of hours)	30	0	0	30			
Status of the course	Elective	Percentage of application of e-learning	0						
	COURSE	DESCRIPTION	-						
Course objectives	<ul> <li>Training students for:</li> <li>understanding of basic</li> <li>understanding of basic and technics used for i</li> <li>interpreting governing</li> <li>analyzing EMC probler</li> <li>measuring radiated EM</li> </ul>	principles of electromagn principles of electromagn ts suppression, EMC standards ns using adequate compu fields both on high and lo	etic con etic con tationa ow freq	mpatib upling I mode uencie	ility (E betwe els, es.	MC), en sys	stems		
Course enrolment requirements and entry competences required for the course	Fundamentals of Electrical Engineering1 & 2.								
Learning outcomes       Students will be able to:         expected at the level       -         of the course (4 to       -         classify types of the electromagnetic interference,									

10 learning outcomes)	<ul> <li>recognize potential EMC problems in practical situations,</li> <li>measure radiated EM fields both on high and low frequencies.,</li> <li>calculate basic parameters of the internal dosimetry using simple human body</li> </ul>									
	- use commercial	antenna	a simulati	on soft	ware for	the analysi	s of the El	MC		
	<ul> <li>compare results obtained by calculations or measurement with relevant EMC standards.</li> </ul>									
	Course content						L or S hours	AE hours		
	Introduction to the er compatibility.	ngineeri	ng mode	ling and	l electro	magnetic	2	0		
	Historical overview of	listorical overview of EMC modeling. 2 0								
	Classification of the	EMC pr	oblems.			·	2	0		
	Signal spectrum, rac	liated er	nissions	and sus	sceptibil	ity.	2	0		
	European and intern	ational	standard	nty. S			2	0		
	Low frequencies (LF	) model	s with co	ncentra	ted para	ameters.	2	0		
	High frequencies (HI	F) mode	els with di	stribute	d paran	neters.	2	0		
	Wire antenna analys	sis in the	EMC ap	plicatio	ns.		2	0		
Course content	Transmission line m	odels.					2	0		
broken down in	Humans and equipm	nent pro	tection fr	om EM	radiatio	n.	2	0		
detail by weekly	Lightning protection	systems	s, ground	ing syst	tems.		2	0		
class schedule (syllabus)	Electromagnetic con systems.	npatibilit	y of collo	cated ra	adio trar	nsmission	2	0		
	List of laboratory or o		LE or DE hours							
	Cable losses measur	rement.		· · ·	••			3		
	Frequency character	ISTICS OF	the elect	ronic cii	rcuits			3		
	Modulations and modulators							3		
	Crosstalk in cables	Julators	•					3		
	Noise measurement	usina in	duction					3		
	Shieldina.	donig in	adottorn					3		
	Calibration of electric	and ma	agnetic fi	eld mea	sureme	nt probes.		3		
	Measurement of elect	tric and	magneti	c field o	f the tra	nsformer st	ation.	3		
	Calibration and meas	suremer	nt of the a	Intenna	parame	eters in GTE	M cell.	3		
	<ul> <li>☑ lectures</li> <li>☑ seminars and wor</li> <li>☑ supplies</li> </ul>	kshops		⊠ inde □ mult	penden timedia	t assignmei	nts			
Format of instruction				⊠ labo	oratory					
				□ worl	k with m	entor				
	$\Box$ partial e-learning				(othe	r)				
Studentresponsibiliti	The presence on lec	tures in	the amo	unt of a	t least 7	0% of the t	imes sche	duled		
es	Performed all require	ed labor	atory exe	ercises.						
Screening student work (name the	Class attendance	2,0	Researc	h		Practical tra	aining			
proportion of ECTS credits for	Experimental work		Report			Individual v	vork	2,0		
eachactivity so that the total number of	Essay		essay			Laboratory	exercises	0,5		
ECTS credits is equal to the ECTS	Tests	0,2	Oral exa	am		laboratory	n for exercises	0,2		
value of the course)	Written exam	0,1	Project			(Oth	ner)			
Grading and evaluating student work in class and at the final exam	There are two midte lecturing and the set take tests they didn't min. and consists of	rms and cond on t pass o 10 que	i final exa e is after n the mic stions or	ams. Th the ne Iterm ex problen	e first m xt 6 wee kams. B ns. In oi	ndterm exar eks. In the f oth midterm rder to pass	n is after inal exam tests last the exam	/ weeks of s students for the 75 n, students		

	are required to finish all laboratory exercises and gain both midterm exams. Final score is determined in foll	n at least 50% lowing way:	of total points at				
	Score(%) = 0,5 (M1 + M	2)					
	where M1 and M2 are midterm exams score.						
	Final grade is determined according the final score:						
	Score         Grade           50% to 62%         sufficient (2)           63% to 75%         good (3)           76% to 88%         very good (4)           89% to 100%         excellent (5)						
	In the final exams students take tests they didn't pass is performed in the written form. It lasts for the 75 mir or problems. In order to pass the exam, students are total points. The final grade is then determined as exp There is possibility to take a seminar instead of the te	s on the midter n. and consists required to gai plained above. est.	rm exams. Exam s of 10 questions n at least 50% of				
	Title	Number of	Availability via				
		the library	other media				
Required literature (available in the	Clayton R. Paul: "Introduction to ElectromagneticCompatibility", Wiley, New Jersey, 2006	the library	other media				
Required literature (available in the library and via other media)	Clayton R. Paul: "Introduction to ElectromagneticCompatibility", Wiley, New Jersey, 2006 Dragan Poljak: "Advanced modelingincomputationalelectromagneticcompatibili ty", WileyInterscience, 2007.	the library	other media				
Required literature (available in the library and via other media)	Clayton R. Paul: "Introduction to ElectromagneticCompatibility", Wiley, New Jersey, 2006 Dragan Poljak: "Advanced modelingincomputationalelectromagneticcompatibili ty", WileyInterscience, 2007. Poljak, D., Dorić, V., Antonijević S.: Modeliranježičanihantenaprimjenomračunala, Kigen, Zagreb, 2009.	the library	other media				
Required literature (available in the library and via other media) Optional literature (at the time of	Clayton R. Paul: "Introduction to ElectromagneticCompatibility", Wiley, New Jersey, 2006 Dragan Poljak: "Advanced modelingincomputationalelectromagneticcompatibili ty", WileyInterscience, 2007. Poljak, D., Dorić, V., Antonijević S.: Modeliranježičanihantenaprimjenomračunala, Kigen, Zagreb, 2009. 1. D.Poljak, <i>Teorijaelektromagnetskihpolja s p</i> . knjigaZagreb, 2014. 2. Tesche F.M.: Janoz M.	the library	other media				
Required literature (available in the library and via other media) Optional literature (at the time of submission of study programme proposal)	Clayton       R.       Paul:       "Introduction       to         ElectromagneticCompatibility",       Wiley,       New Jersey,         2006         Dragan Poljak:       "Advanced         modelingincomputationalelectromagneticcompatibili         ty",       WileyInterscience,       2007.         Poljak,       D.,       Dorić,       V.,         Antonijević S.:       Modeliranježičanihantenaprimjenomračunala,         Kigen,       Zagreb,       2009.         1.       D.Poljak, <i>Teorijaelektromagnetskihpolja s pr</i> knjigaZagreb,         2.       Tesche,       F.M.:       Ianoz,       M.'         EMCAnalysisMethodsandComputationalMod       3.       Macnamara, T.:       HandbookofAntennas for EM	<i>the library</i> <i>rimjenama u i</i> V., Kars lels, John Wile <i>I</i> C, Artech Hou	other media inženjerstvu, Šk. slsson, T.: y&Sons, 1997 use, 1995.				
Required literature (available in the library and via other media) Optional literature (at the time of submission of study programme proposal) Quality assurance methods that ensure the acquisition of	ClaytonR.Paul:"IntroductiontoElectromagneticCompatibility", Wiley, New Jersey, 2006Dragan Poljak: "Advanced modelingincomputationalelectromagneticcompatibili ty", WileyInterscience, 2007.Poljak, D., Dorić, V., Antonijević S.: Modeliranježičanihantenaprimjenomračunala, Kigen, Zagreb, 2009.1.D.Poljak, <i>Teorijaelektromagnetskihpolja s pl</i> knjigaZagreb, 2014.2.Tesche,F.M.:1.Index (State)2.Tesche,4.EMCAnalysisMethodsandComputationalMod 3.3.Macnamara, T.: HandbookofAntennas for EM Evaluation of results in accordance with the a Feedback from students via surveys Self-evaluation of teachers	the library <i>rimjenama u i</i> V., Kars lels, John Wile <u>MC, Artech Hou</u> above learning	other media inženjerstvu, Šk. slsson, T.: y&Sons, 1997 use, 1995. outcomes				
Required literature (available in the library and via other media) Optional literature (at the time of submission of study programme proposal) Quality assurance methods that ensure the acquisition of exit competences	Clayton       R.       Paul:       "Introduction       to         ElectromagneticCompatibility",       Wiley,       New Jersey,         2006         Dragan Poljak:       "Advanced         modelingincomputationalelectromagneticcompatibility",       WileyInterscience, 2007.         Poljak, D.,       Dorić, V.,       Antonijević S.:         Modeliranježičanihantenaprimjenomračunala,       Kigen,         Kigen,       Zagreb, 2009.       1.         1.       D.Poljak, <i>Teorijaelektromagnetskihpolja s p.</i> knjigaZagreb, 2014.       2.       Tesche,         2.       Tesche,       F.M.:         2.       Tesche,       F.M.:         2.       Tesche,       F.M.:         3.       Macnamara, T.:       HandbookofAntennas for EM         -       Evaluation of results in accordance with the a         -       Feedback from students via surveys         -       Self-evaluation of teachers         -       Institutional and non-institutional evaluations	<i>the library</i> <i>rimjenama u i</i> V., Kars lels, John Wile <u>AC, Artech Hot</u> above learning	other media inženjerstvu, Šk. slsson, T.: y&Sons, 1997 use, 1995. outcomes				

NAME OF THE COURSE	RADIO COMMUNICATIONS								
Code	FELO30	Year of s	tudy	3.					
Course teacher	Zoran Blažević, Ph.D., Full Professor	Credits (E	ECTS)	5					
Associate teachers	Maja Škiljo, Ph.D., Assistant	Type of ir (number	nstruction of hours)	L 30	S 0	AE 15	LE 15	DE 0	
Status of the course	Elective	ive Percentage of application of e-learning 0							
	COURSE	E DESCRI	PTION						
Course objectives	<ul> <li>understanding and application of basic principles and mechanisms of Earth radio-propagation,</li> <li>basic radio-channel physical phenomena modelling,</li> <li>permanent adoption and deepening of knowledge in the field of radio engineering.</li> </ul>								
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)	<ul> <li>Students will be able to:</li> <li>define the fundamental phenomena, the quantities and the laws of Earth radio-propagation,</li> <li>apply fundamental laws of radio-propagation and model basic radio-channels,</li> <li>calculate and estimate basic radio-channel parameters,</li> <li>apply basic methods of radio-channel measurements</li> </ul>								
	Course content					L hours	A ho	\E ours	
	Introduction to Radio Communications. History perspective of radio engineering. SI units.							-	
	Antennas. Radiowave prop	agation.				4		3	
	Atmospheric influence on radio-propagation-propagation by troposphere.							1	
Course content	Atmospheric influence on radio-propagation-propagation by ionosphere.							1	
broken down in	Propagation by diffraction					4		3	
class schedule	Propagation by reflection.					6		3	
(syllabus)	Digital radio-communication	n channel.	Shannon theore	em.		2		4	
	Cellular radio systems					2		1	
	Midterm exam								
	List of laboratory exercises	otrumonto	dovices and at	horog	inmo	<b>.</b> +		nours	
	Antenna parameters measu	struments	, devices and oti	nerequ	lipmei	π		5	
	Radio-channel parameters	measurem	ents by spectru	m anal	vser			4	
	Measurements of radio-cha	innels by v	ector network a	nalyser	,			3	
	Software estimations of rad	io-channe	S					2	
Format of instruction	☑ lectures       □ independent assignments         □ seminars and workshops       □ independent assignments         □ sectorizes       □ multimedia         □ on line in entirety       □ work with mentor         □ partial e-learning       □ (other)								
Studentresponsibiliti	The presence on lectures i	n the amo	unt of at least 70	) % of t	he tim	ies scł	nedule	d.	
es	Performed all laboratory ex	cercises re	quired.						

Screening student	Class attendance	2,0	Research		Practical training	ng	
proportion of ECTS	Experimental work		Report		Individual work	K	1.5
credits for eachactivity so that	Essay		Seminar essay		Laboratory exe	ercises	0,8
the total number of ECTS credits is	Tests	0,5	Oral exam		Preparation for laboratory exe	r rcises	0,2
value of the course)	Written exam		Project		(Other)		
Grading and evaluating student work in class and at the final exam	<ul> <li>here are one midterm and one final exam. Both midterm test and final test consist of theoretical questions and numerical problems. The students that did not pass the nidterm exams take part In the final exams. The midterm and final exams are carried but as written tests. The requirement for passing grade is the positive assessment of aboratory exercises, 40 % points on the midterm exam or the final exam, and the est of the grade depends on the seminary work presented by the student. Grade (in percentage) is formed according to the formula: Grade(%) = 0,1 NP + 0,1 LV + 0,4 (M + S)</li> <li>he activities in percentage:</li> <li>NP - attendance at lectures,</li> <li>LV - laboratory assessment,</li> <li>M - test results.,</li> <li>S - seminary work results and presentation</li> </ul>						
	Title			Number of copies in the library	Availabi other n	lity via nedia	
Required literature (available in the	I. Zanchi, Z. Blažević: Radiokomunikacije, predavanja, EESB					e-lear port	ning tal
library and via other media)	Boithias, L.: Radio WavePropagation, North Oxford Academic 1987.				1		
	Zentner, E.: Radioko Zagreb, 1980.	omunika	cije, Školska knji	iga -	2		
Optional literature (at the time of submission of study programme proposal)	Zentner, E.: Antene Parsons, J. D.: "The Publishers - London Doble, J.: "Introducti Communications", A	i radiosu Mobile , GB, 19 on to Ra rtech Ho	ustavi, Graphis Z Radio Propagati 92. adio Propagation buse Boston - Lo	agreb, 2 on Chai for Fixe ondon, (	2001. nnel", Pentech ed and Mobile 3B, 1996.	Press	
Quality assurance methods that ensure the acquisition of	<ul> <li>Evaluation of results in accordance with the above learning outcomes</li> <li>Feedback from students via surveys</li> <li>Self-evaluation of teachers</li> <li>Institutional and non-institutional evaluations</li> </ul>						
proposal) Quality assurance methods that ensure the acquisition of	<ul> <li>Communications", Artech House Boston - London, GB, 1996.</li> <li>Evaluation of results in accordance with the above learning outcomes</li> <li>Feedback from students via surveys</li> <li>Self-evaluation of teachers</li> <li>Institutional and non-institutional evaluations</li> </ul>						

NAME OF THE COURSE	HUMAN EXPOSURE TO ELECTROMAGNETIC RADIATION								
Code	FELO32	Year of study	3.						
Course teacher	Vicko Dorić, Ph.D., Associate Professor	Credits (ECTS)	5						
Associate teachers	Anna Šušnjara	Type of instruction (number of hours)	L 30	S 0	AE 0	LE 30	DE		
Status of the course	Elective	Percentage of application of e-learning	0						
	COURSE	DESCRIPTION							
Course objectives	<ul> <li>Training students for:</li> <li>understanding and application of basic principles of electromagnetic and thermal dosimetry,</li> <li>assessment of human exposure to a sources of both high frequency and low frequency electromagnetic fields,</li> <li>accepting knowledge from the area of the bio electromagnetics,</li> <li>using national and international legislation for the assessment of human exposure to a sources of human exposure to a sources,</li> </ul>								
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)	<ul> <li>Students will be able to:</li> <li>define the fundamental terms in bio electromagnetics,</li> <li>measure external EM fields both on high and low frequencies,</li> <li>calculate external EM fields both on high and low frequencies</li> <li>analyze levels of human exposure to EM radiation according to national and international legislation,</li> <li>calculate basic parameters of the internal dosimetry using simple human body models,</li> <li>use commercial software packages for the internal dosimetry analysis based on</li> </ul>								
	Course content			L	or S	/ hc	λE		
	Electromagnetic pollution	Ionizing and non-ionizing r	adiatio	n	2		0		
	EM field coupling to humar fields. High and low freque statistical studies.	M	2		0				
	Basic parameters of electro density, induced electric fie external fields, power dens	,	2		0				
Course content broken down in detail by weekly	Electromagnetic radiation p international legislation. Ba levels.	protection guidelines. Nations is crestrictions and referer	onal and nce	b	2		0		
class schedule	Methods for the theoretical Incident and internal field d	and experimental dosime losimetry.	try.		2		0		
(09110000)	Characterization of the rad measurement of the low fre the power lines and transfo	iation sources. Calculation equency electric field. Expo ormer stations.	and osure to	)	2		0		
	Calculation and measurem Exposure to the RFID ante stations.	ent of the high frequency l nnas, mobile phones and	EM field base	J.	2		0		
	Classification of the interna anatomical models of the h	Il dosimetry models. Simpl uman body.	ified an	d	2		0		
	Electromagnetic modeling frequencies (LF). Whole bo	of the human body at low ody exposure to the LF fiel	ds.		2		0		

	Electromagnetic mo frequencies (HF). Hu	deling o uman ey	f the hum /e and br	nan bod ain expo	y at higl osure to	h ) the	2	0
	Human exposure to	the tran	sient fiel	ds.			2	0
	Thermal response of fields. Thermal response of fields.	f the hui onse of	man body the huma	y expose an eye a	ed to th Ind brai	e HF n exposed	2	0
	Biomedical application the nerves. Laser tre	ons of E eatment	M fields. of the ey	Electric e. Brain	al stimu	ulation of ation	2	0
	methods. Transcran	ial magr	netic stim	ulation	(TMS)			LE or DE
	List of laboratory or	design e	exercises					hours
	Simulation models for the human exposure to nonionizing EM radiation (frequencies up to 10 MHz)							4
	Simulation models for	r the hu	man exp	osure to	o nonior	nizing EM ra	diation	4
	(frequencies above 1 Measurement setup	0 MHz) and met	hods for	the ass	essmer	t of human	exposure	•
	to EM fields.			110 035	Coomer		exposure	6
	LF electric fields mea	asureme	ent.					4
	LF magnetic fields m	easurer	nent. Pasureme	ent				4
	EM field calculation in vicinity of the base station.							4
Format of instruction	<ul> <li>☑ lectures</li> <li>☑ seminars and workshops</li> <li>☑ exercises</li> <li>☑ on line in entirety</li> <li>☑ partial e-learning</li> <li>☑ laboratory</li> <li>☑ work with mentor</li> </ul>					nts		
	□ field work							
Studentresponsibiliti es	The presence on lect Performed all require	tures in ed labor	the amo atory exe	unt of at ercises.	t least 7	0 % of the t	imes sche	duled.
Screening student work (name the	Class attendance	2,0	Researc	ch		Practical tra	aining	
proportion of ECTS	Experimental work		Report			Individual v	work	2,0
credits for eachactivity so that	Essay		Semina essay	r		Laboratory exercises		0,5
ECTS credits is	Tests	0,2	Oral exa	am		Preparation laboratory	aration for ratory exercises	
value of the course)	Written exam	0,1	Project			(Oth	ner)	
	There are two midterms and final exams. The first midterm exam is after 7 weeks or lecturing and the second one is after the next 6 weeks. In the final exams students take tests they didn't pass on the midterm exams. Both midterm tests last for the 75 min. and consists of 10 questions or problems. In order to pass the exam, students are required to finish all laboratory exercises and gain at least 50% of total points a both midterm exams. Final score is determined in following way:							
Grading and evaluating student			Score(%	b) = 0,5	(M1 + N	М2)		
work in class and at the final exam	where M1 and M2 a	re midte	rm exam	s score				
	Final grade is deterr	nined ad	cording	the final	score:			
	Score         Grad           50% to 62%         suffi           63% to 75%         good           76% to 88%         very           89% to 100%         excel	de cient (2) d (3) good (4 ellent (5)	) 4)					

	In the final exams students take tests they didn't p is performed in the written form. It lasts for the 75 or problems. In order to pass the exam, students a total points. The final grade is then determined as	ass on the midte min. and consist re required to ga explained above	rm exams. Exam s of 10 questions in at least 50% of
Required literature (available in the library and via other media)	Title	Number of copies in the library	Availability via other media
	D.Poljak, Teorija elektromagnetskih polja primjenama u inženjerstvu, Šk. knjiga Zagreb, 201	s 4. 5	
	D. Poljak: Izloženost ljudi elektromagnetsko zračenju, Kigen, Zagreb, 2007.	<sup>m</sup> 5	
Optional literature (at the time of submission of study programme proposal)	<ol> <li>D. Poljak, AdvancedModelinginComputative WileyInterscience, New York 2007.</li> <li>D. Poljak: Human Exposure to Elective Southampton-Boston, 2003</li> <li>R.W.Y. Habash, ElectromagneticFieldsan</li> <li>D. Poljak: ExposureofHumansive SoftCOMLibrary 2002.</li> </ol>	onalElectromagi romagnetic Fiel dRadiation, Marc to Electrom	neticcompatibility, lds, WIT Press, cel Dekker, 2002. agneticRadiation,
Quality assurance methods that ensure the acquisition of exit competences Other (as the	<ul> <li>Evaluation of results in accordance with th</li> <li>Feedback from students via surveys</li> <li>Self-evaluation of teachers</li> <li>Institutional and non-institutional evaluation</li> </ul>	e above learning ns	outcomes
proposer wishes to add)			

NAME OF THE COURSE	COMPUTER AIDED ANALYSIS OF RADIATING STRUCTURES								
Code	FELO31	Year of study	3.						
Course teacher	Vicko Dorić, Ph.D., Associate Professor	Credits (ECTS)	5						
Associate teachers	Maia Škilio, Ph D	Type of instruction	L	S	AE	LE	DE		
Associate teachers	Maja Skiljo, Ph.D.	(number of hours)	30	0	0	30			
Status of the course	Elective	Percentage of application of e-learning	0						
	COURSE	E DESCRIPTION							
Course objectives	<ul> <li>Training students for:</li> <li>understanding of basic principles and laws of electromagnetics,</li> <li>knowing basic terms and principles of antennas and EM waves propagation,</li> <li>using commercial software packages for wire antenna analysis.</li> </ul>								
Course enrolment requirements and entry competences required for the course	Authematics, Fundamentals of Electrical Engineering.								
Learning outcomes       Students will be able to:         expected at the level       -         of the course (4 to       -         classify numerical methods for engineering problems,									

10 learning outcomes)	<ul> <li>name and explain basic antenna parameters,</li> <li>recognize characteristic parameters of the radiation pattern,</li> <li>use software package SuzANA,</li> <li>use software package NEC.</li> </ul>								
	Course content	en gen					L or S	AE	
	Introduction. Electric	; field. M	lagnetic f	ield. Ma	axwell eq	quations in	2	0	
	Electrical properties of the materials. Isotropic, linear and homogenous materials. Boundary conditions.							0	
	Electromagnetic way space. Reflection of	/es. Pla the perf	ne wave ectly con	propaga ducting	ation in f bounda	ree iry.	2	0	
	Electromagnetic rad	Electromagnetic radiation. Hertz dipole. Image method.							
	Introduction to the nu domain analysis. Do	umerica main di: ds	l modelin scretizatio	g. Freq on meth	uency a lods. Bo	nd time undary	2	0	
	Introduction to the F	inite ele	ment me	thod.			2	0	
Course content	Introduction to the an Polarization.	ntenna t	heory. A	ntenna	paramet	ers.	2	0	
broken down in	Radiation pattern. D	irectivity	r. Gain.				2	0	
detail by weekly	Radiated power and	radiatio	n resista	nce. Ne	ar and f	ar field.	2	0	
class schedule	Typical antenna syst	tems.					2	0	
(syllabus)	Antenna design.	odolina	in froque	nov dor	moin		2	0	
	Basics of antenna m		in time d	omain -	direct :	and	Ζ	0	
	indirect approach.	2							
	List of laboratory or o	design e	exercises					LE OF DE	
	FM waves propagatir	na in die	lectric					2	
	EM wave incident to	the PEC	c ground					2	
	Short dipole radiated	EM fiel	d					2	
	Software package Su	JZANA -	- frequen	cy dom	ain			4	
	Software package Su	IZANA -	- time do	main				4	
	Software package N	EC						6	
	Design and analysis of a commercial antenna system using NEC software							10	
				r					
	☑ lectures			⊠ inde	penden	t assignmer	nts		
	□ seminars and wor	kshops		□ mult	imedia				
Format of instruction	⊠ exercises			⊠ labo	ratory				
	<i>□on line</i> in entirety				c with m	entor			
	□ partial e-learning				(other	·)			
	□ field work				(other	)			
Studentresponsibiliti es	The presence on lect Performed all require	tures in ed labor	the amo atory exe	unt of a prcises.	t least 7	0 % of the t	imes sche	eduled.	
Screening student work (name the	Class attendance	2,0	Researc	:h		Practical tra	aining		
proportion of ECTS	Experimental work		Report			Individual w	vork	1,0	
eachactivity so that	Essay		Seminal essay			Laboratory	exercises	s 1,5	
ECTS credits is	Tests	0,2	Oral exa	am		Preparation laboratory	n for exercises	0,2	
value of the course)	Written exam	0,1	Project			(Oth	er)		
Grading and evaluating student work in class and at the final exam	There are two midte lecturing and the set take tests they didn't min. and consists of	rms and cond on t pass o 10 ques	l final exa e is after n the mic tions or p	the nex the nex Iterm ex roblems	e first m xt 6 wee kams. Fi s. <u>F</u> or the	idterm exan eks. In the fi rst midterm e second mi	n is after inal exam test lasts dterm exa	7 weeks of s students for the 75 am student	

	is required to present computer model of a commercial antenna system developed during laboratory exercises. In order to pass the exam, students are required to finish all laboratory exercises, gain at least 50% of total points at first midterm exam and positive evaluation of the second midterm exam. Final score is determined in following way: Score(%) = 0,5 (M1 + M2)							
	where M1 and M2 are midterm exams score.							
	Final grade is determined according the final score:							
	Score         Grade           50% to 62%         sufficient (2)           63% to 75%         good (3)           76% to 88%         very good (4)           89% to 100%         excellent (5)							
	In the final exams students take tests they didn't pass is performed in the written form for the first part and part of the course. In order to pass the exam, studer 50% of total points at written exam and positive evalua- grade is then determined as explained above.	s on the midter in the oral forn ats are require ation of the ora	rm exams. Exam m for the second d to gain at least Il exam. The final					
	Title	Number of copies in the library	Availability via other media					
Required literature	Poljak, D., Dorić, V., Antonijević S.: Modeliranje žičanih antena primjenom računala, Kigen, Zagreb, 2009.							
(available in the library and via other media)	G. J. Burke, A.J. Poggio, "Numerical Electromagnetics Code NEC Method of Moments – Part III: User's guide", Lawrence Livermore National Laboratory, 1981.							
	E. Zentner: Antene i radiosustavi, Graphis, Zagreb 2001.							
	Poljak, D., Dorić, V., Antonijević S.: Modeliranje žičanih antena primjenom računala, Kigen, Zagreb, 2009.							
Optional literature (at the time of submission of study programme proposal)	D.Poljak, <i>Teorija elektromagnetskih polja s primjena</i> Zagreb, 2014. D.Poljak N.Kovač, V. Dorić, Numeričke metode u e FESB-Split 2006. Macnamara, T.: Handbook of Antennas for EMC, Arte	a <i>ma u inženje</i> elektrotehnici - ech House, 19	<i>rstvu</i> , Šk. knjiga - interna skripta, 95.					
Quality assurance methods that ensure the acquisition of	<ul> <li>Evaluation of results in accordance with the a</li> <li>Feedback from students via surveys</li> <li>Self-evaluation of teachers</li> </ul>	above learning	outcomes					
exit competences Other (as the proposer wishes to add)	- Institutional and non-institutional evaluations							

NAME OF THE COURSE	SENSORS AND TRANSDUCERS						
Code	FELO36	Year of study	3.				
Course teacher	Josip Musić, Ph.D., Assistant Professor	Credits (ECTS)	4				
Associate teachers	Ivo Stančić, Ph.D., Assistant Professor	Type of instruction (number of hours)	L 30	S 0	AE 0	LE 15	DE 0
Status of the course	Elective	Percentage of application of e-learning	of of e-learning 0				
	COURSE	E DESCRIPTION					
Course objectives	<ul> <li>Training students for:</li> <li>understanding role and significance of measurement equipment and measurement transducers in autonomous systems via control loops.</li> <li>acquiring basic practical knowledge about physical limitations and possible issues while using different measurement equipment and transducers.</li> <li>understanding working principles of different sensors as well as their advantages and disadvantages.</li> </ul>						
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)	<ul> <li>recognize sensors and transducers in automatic control loops.</li> <li>explain importance of sensors and transducers in automation.</li> <li>explain basic characteristic of measurement transducers (and sensors).</li> <li>give examples of some of widely used sensors (pressure sensors, flow sensors, temperature sensors, optical sensors, inertial sensors).</li> <li>examine sensor datasheets,</li> <li>apply basic measurement transducers.</li> <li>evaluate A/D and D/A work principle and its influence on measurements/control.</li> </ul>						
	Course content						
	Introductory considerations and systematic approach to automatic						
	control. Measurement sensor and actuators in the control loop. Sensor and transducer types. General consideration of most important						
	A/D and D/A converters and their influence and sensor characteristics						
	Application examples of measurement sensors in control loops						2
Course content broken down in detail by weekly class schedule (syllabus)	Pressure sensors: capacitive, inductive, resistive and piezoelectric (working principles, characteristics and applications).						2
	Inertial sensors: accelerometer (working principles, characteristics and applications).						2
	Inertial sensors: gyroscope (working principles, characteristics and applications).						2
	Inertial sensor units (inertial sensors + magnetometers): working principles, characteristics and applications.						2
	Optical sensors: photoresistors, photodiodes, position sensors (encoders) and shift sensors (working principles, characteristics and applications).						2
	Pressure and force sensors: types, working principles, characteristics and applications.						2
	Flow sensors: mechanical, ultrasonic and magnetic (working principles, characteristics and applications).						2

	Intelligent sensors. Dislocated measurement devices: measuring at distant location						2
	Actuators and senso	ors: func	tional uni	t.			2
	List of laboratory or (	desian e	exercises				LE or DE
					omonto	haraatariatiaa	hours
	Temperature sensors: application ad measurement characteristics. Pressure and touch sensors: QTC (quantum tunneling compound) and tasters.						3
							3
	Distance sensors: capacitive ultrasound and laser. Inertial sensors and magnetometers.					3	
							3
	Serve motors, control and measurement transducers. 3						
	□ seminars and workshops						
	⊠ multimedia						
Format of Instruction	<i>□on line</i> in entirety				k with m	entor	
	□ partial e-learning				(othe	r)	
	□ field work						
Studentresponsibiliti es	The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises.						
Screening student	Class attendance	1	Researc	h		Practical training	
proportion of ECTS credits for eachactivity so that the total number of ECTS credits is	Experimental work		Report			Individual work	1,2
	Essay		Seminai essay			Laboratory exercises	1,5
	Tests	0,1	Oral exa	ım	Preparation for		0,1
equal to the ECTS value of the course)	Written exam	0,1	Project		(Other)		
Grading and evaluating student work in class and at the final exam	During the semester there are two midterm exams. The first midterm exam is after 7         weeks of lectures and the second one is after 13 weeks of lectures. Each midterm test (as well as the final test) is carried out in a written format with duration of 90 minutes. It consists of both theoretical questions and numerical problems. In the final exams students that did not pass the midterm exams take part. The final exam test consists of 6 theoretical questions and numerical problems. The requirement for passing grade is the positive assessment of laboratory exercises and 50 % points on average midterm exam (M1 + M2)/2) or the final exam. Students are allowed to have at least 40% of total points on each midterm exams, as long as the final midterm average is at least 50% of total points.         Grade (in percentage) is formed according to the formula:         Grade(%) = 0,5L + 0,5(M1 + M2)         where:         •       L – laboratory assessment,         •       M1, M2 – midterm test results.         Final grade (based on percentages) is formed as follows:         Percentage       Grade         50% do 62%       sufficient (2)         63% do 74%       good (3)         75% do 86%       very good (4)         87% do 100%       excellent (5)         According to Article 65. of Faculty's Bylaw, student is required to participate in all teaching activities attending at least 70% of lectures, and 100% of laboratory exercises. In accordance with that student is required to solve and turn over for						

	or he won't be able to take part in the final exam, and will be required to enroll in the course the next year.						
Required literature (available in the library and via other media)	Title	Number of copies in the library	Availability via other media				
	Božičević, J.: Temeljiautomatike 1, Školskaknjiga , Zagreb, 2008.	2					
	Šurina, T.: Automatskaregulacija, Školskaknjiga, Zagreb, 1981.	1					
	M.B. Histand, D.G. Alciatore: Introduction to Mechatronics and Measurement Systems, McGraw Hill, 1999.		teacher/Internet				
	<ol> <li>Stančić, Guidelines for laboratory exercises, FESB</li> </ol>		e-learning portal				
	J. Musić: Authorized lecture notes, FESB		é-learning portal				
Optional literature (at the time of submission of study programme proposal)	<ol> <li>2. Friedland, B.: Control System Design, McGraw-Hill, New York, 1986.</li> <li>2. Sinclair, I.: Sensors and Transducers, 3<sup>rd</sup> edition, Newnes, Oxford, 2001.</li> </ol>						
Quality assurance methods that ensure the acquisition of exit competences	<ul> <li>Keeping records of student attendance.</li> <li>Annual analysis of course statistics in terms of midterm and finals exams</li> <li>Feedback from students via surveys.</li> <li>Feedback from graduated students (or senior students) on course content relevance.</li> <li>Self-evaluation of teachers.</li> <li>Periodic institutional evolution of course teachers.</li> </ul>						
Other (as the proposer wishes to add)	/						