

UNIVERSITYOFSPLIT

FACULTY OF ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE

DETAILED PROPOSAL OF THE STUDY PROGRAMME

GRADUATE UNIVERSITY STUDY IN AUTOMATION AND SYSTEMS

SPLIT, February 2022

1.1. List ofmandatory and elective courses

	List ofcourses										
Year of study:1.											
Semester:I.											
OTATUS	CODE	COURSE	HO	URSI	N SEI	NEST	ER*	готе			
51A105	CODE	COURSE		S	AE	LE	DE	ECIS			
	FEMG01	Modern physics	30	0	0	30	0	4			
Mandatory	FELK04	Computer graphics	30	0	0	30	0	5			
	* L = lectures, S = seminars, AE = auditoryexcercise, LE = laboratoryexcercise, DE = design excercise										
	FELG32	Telemedicine and Biocybernetics	30	0	0	30	0	5			
	* L = lecture	es, S = seminars, AE = auditoryexcercise, LE = labora	atoryexc	cercise	, DE =	design	excerci	se			
Elective											

List ofcourses										
Year of study	:1.									
Semester:II.										
	CODE	COURSE	НО	ECTS						
STATUS	CODE	COURSE		S	AE	LE	DE	ECIS		
	FELH35	<u>Solar cells</u>	30	0	0	30	0	5		
	FELG33	Optoelectronic measurement methods	30	0	0	30	0	5		
	* L = lecture	es, S = seminars, AE = auditoryexcercise, LE = labora	atoryexo	cercise	, DE =	design	excerci	se		

List ofcourses										
Year of study	:2.									
Semester:III.										
	CODE	COURSE		URS I	N SEI	MEST	ER*	ECTS		
				S	AE	LE	DE	ECIS		
STATUS	FELG23	Optimization and optimal systems	30	0	30	0	0	5		
	FELG24	Microcontrollers and network embedded systems	30	0	0	30	0	5		
	* L = lecture	es, S = seminars, AE = auditoryexcercise, LE = labor	atoryex	cercise	, DE =	design	excerci	se		

1.2. Course description

NAME OF THE COURSE	MODERN PHYSICS									
Code	FEMG01	Year of study	1.							
Course teacher	Nikola Godinović, Ph.D., Associate Professor	Credits (ECTS)	4							
	DuniaPolić, Darko Zarić	Type of instruction	L	S	AE	LE	DE			
Associate teachers	Toni Vrdoljak	(number of hours)	30	0		30	0			
Status of the course	Obligatory	Percentage of application of e-learning	0							
	COURSE	E DESCRIPTION								
Course objectives	Understanding the basic la ofquantumphysicsandtheir technologyandinformation. theadoptionoffurtherexpert theadoptionofprofessional	of derstanding the basic laws and concepts of quantumphysics and their application in modernengineering techniques, technology and information. The acquired knowledges erves as a basis for the adoption of further expertise through specialized courses, as well as prepar the adoption of professional knowledge through out his career.								
Course enrolment requirements and entry competences required for the course										
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Developing ability of abstract thinking anduinderstanding the concepts of quantum physics on which modern technologies are based Understanding of the electric and magnetic properties of the materials starting from their atomis structure Understanding the fenomenology of superconductors. Basicunderstanding of nuclear physics and their application for energy generation as well as basicunders tanding of fradioactivity and dosimetry. Become familiar with modern diagnostic methods and treat ments in medicne: nuclear magnetic resonance (NMR), positrone mission to mography (PET),									
	Course content			h	L ours	h	LE ours			
	Special theory of relativity				2					
	General theory of relativity				2					
	Particle properties of wave	S			2					
Course content	Wave properties of particle	1			2					
broken down in	Introduction to wave mecha	anics - Schrodinger equat	ion		2					
detail by weekly	Application of Schrodinger	equation			2					
class schedule	Schrodinger equation for h	ydrogen atom			2					
(syllabus)	Electrical properties of mat	erial			2					
	Semiconductors				2					
	Magnetic properties of mat	erial			2					
	Phenomenology of superconductor 2									
	Atomic nuclei	tomic nuclei 2								
	Application of nuclear phys	sics			2					
	List oflaboratoryor design e	List of laboratory or design exercises LEhours								
	Basics statistics of data an	Basics statistics of data analysis 4								
	Light Interrerence	f electron charge and mar	29				2			
	Photoelectric effect	a clothon onargo and mat					2			

	Spectral line of gass	es						2		
	Solar cell characteris	sation						2		
	Hall effect							2		
	Semiconductor phot	o detec	tors					4		
	Demonstrations of m	nagnetis	m					2		
	Demonstration of the	e pheno	menolog	y of sup	ercondu	ictor		2		
	Dosimetry							2		
	Measurement of the	gamma	a-rays spe	ectrum				4		
	⊠ <u>lectures</u>	Iectures								
	□ seminars and wor	kshops			imedia	assignments				
Format of instruction	⊠ <u>exercises</u>				rotory					
Format of Instruction	□ on linein entirety				<u>natory</u>	ontor				
	□partial e-learning				(ath a					
	☐ field work				(other	()				
Studentresponsibiliti es	The presence on lec	tures in	the amo	unt of at	t least 7	0 % of the time	s sched	luled.		
Screening student	Class attendance	1,0	Researc	h		Practical trainin	ng			
proportion of ECTS	Experimental work		Report			Individual work	(2,6		
eachactivity so that	Essay		Seminai essay	-		(Other)				
ECTS credits is	Tests	0,2	Oral exa	ım		(Other)				
value of the course)	Written exam	0,2	Project			(Other)				
	midterm exam is aft weeks. Each midter questions: The requirement for from each of 4 ques retake it during the fi	midterm exam is after 7 weeks of lectures and the second one is after the next 6 weeks. Each midterm test lasts for 90 minutes and consists of the following 4 questions: The requirement for passing grade at the midterm exams is to have at least 50% from each of 4 questions. Students that do not pass one of the midterm exams can retake it during the final exams. Final exams lasts 135 minutes each and consist out								
	of the following 6 questions: The requirement for passing grade at the final exam is to have at 50% from each of									
Grading and evaluating student	6 questions.									
evaluating student work in class and at the final exam	Final grade is determined using the relative grading system based on the arithmetic mean of the per cents of each of the additional questions. Students that have passed both midterm exams or final exams are grouped in four categories: 15% of the students with the highest arithmetic means are assigned grade A (excellent), 35% of the students with the next best arithmetic means are assigned grade B (very good), 35% of the students with the next to next best arithmetic means are assigned grade C (good), and 15% of the students with the lowest passing arithmetic means are assigned grade D (satisfactory). Students who fail to pass the course through midterms and/or final exams have one make-up exam at the beginning of fall. This exam features the same format as the final exam									
	Exam schedule is pr	edetern	nined thro	ough the	e acader	nic calendar.				
Required literature		Title	•			Number of copies in the library	Availal other	oility via media		
(available in the library and via other media)	 Knapp, V.; Colić, magnetskasvojst Zagreb, 1997 	P.: Uvo vamate	od u elekt rijala, Ško	rična i olskaknj	iga,					
	I. Supek, M. Furi- Zagreb, 1994.	ć: Poče	afizike, Š	kolskak	njiga,					

	A. Beiser: Concepts of Modern Physics, sixth edition, McGraw-Hill 2003						
Optional literature (at the time of submission of study programme proposal)	 E.V. Wichmann: KvantnaFizika, udžbenikfizikeSv Tehničkaknjiga, Zagreb, 1988. D. Halliday, R. Resnick, J. Walker: Fundamentals Wiley & Sons, Inc., 2013. Vladimir Šips, Uvod u fizikučvrstogstanja, Školska 	eučilišta u Ber of Physics 10t aknjiga 2000.	keley, svezak 4., h edition, John				
Quality assurance methods that ensure the acquisition of exit competences Other (as the proposer wishes to	 Student evaluation surveys Teacher self-evaluat Institutionalandnon-institutionalevaluations 	ion					

NAME OF THE COURSE	COMPUTER GRAPHICS									
Code	FELK04	Year of study	1.							
Course teacher	Vladan Papić, Ph.D., FullProfessor	Credits (ECTS)	5							
Associate teachers	Denis Štajduhar, mag.	Type of instruction	L	S	AE	LE	DE			
			30	0	0	30	0			
Status of the course	Obligatory	Percentage of application of e-learning	0							
	COURSE	DESCRIPTION								
Course objectives	 raining students for: understanding of basic principles and algorithms of computer graphics, understanding of computer graphics technologies, design and applications of computer graphics algorithms in C programming language and utilization of graphical libraries in programming 									
requirements and entry competences required for the course	None									
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: explain graphical pipeli analyse basic algorithm connect sequence of g transformation for view recommend type of shates critical argue on possible technologies, model simpler objects create simpler animation 	ine, ns of computer graphics, , graphical transformations i , ading and animation in orc pilities and limitations of va with computer modelling s ons with software tools,	n orde ler to a rious d oftware	r to acl chieve lisplay e tools	hieve desir and h	neede ed res ardcop	d ult, yy			

	 create simpler constraints 	ompute	r program	is for ol	oject pre	esentation u	sing graph	ical
	Course content						L hours	AE hours
	Uvod						2	nouro
	Imageelements, vec	torand r	aster sys	tems,			2	
	interactivegraphicsco	oncept					2	
	Basicalgorithmsofco	mputer	graphics				2	
	Primitivestillingandci	ipping					2	
	Antiplicai naruware						4	
	Geometrictransform	ations					2	
Course content	Objectsin 3D space						2	
broken down in	Curvesandsurfaces							
detail by weekly	Lightningandshading							
class schedule	Animation	,					2	
(syllabus)	List of laboratory exe	ercises						LE hours
	Introducton to OpenC	GL						4
	OpenGLexercise: An	imation						2
	OpenGLexercise: Te	xtures						2
	OpenGLexercise: Te	thingan	ers dinteracti	ion				2
	OpenGLexercise: Co		2					
	OpenGLexercise: 3D		4					
	Blender: modelling							4
	Blender: animation							4
	□ seminars and workshops							
	□ exercises ⊠ multimedia							
Format of instruction	□ on line in entirety							
	□ partial e-learning							
	☐ field work				(otne	er)		
Studentresponsibiliti es	The presence on lect Performed all require	tures in ed labor	the amoratory exe	unt of a ercises.	t least 7	'0 % of the t	imes sche	duled.
Screening student	Class attendance	1,5	Researc	h		Practical tra	aining	
proportion of ECTS	Experimental work		Report			Individual v	vork	1,4
credits for eachactivity so that	Essay		Seminar essay	•	0,8	Laboratory	exercises	0,5
the total number of ECTS credits is	Tests	0,2	Oral exa	am		Preparation laboratory	n for exercises	0,5
value of the course)	Written exam	0,1	Project			(Oth	ier)	
Grading and evaluating student work in class and at the final exam	There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. In the final exams students are answering parts they did not pass in the midterms. The midterm and final exams are carried out as written testsanditlasts for max. 60 minutes. The requirement for passing grade is 50% points on eachmidtermexamorfinalexam writtenandaccepted seminar workandpositive assessment of laboratory exercises. In finalgrading (inpercentage), eachmidtermexamcontributeswithmax. 30%, seminar workwithmax. 30%, lab. exerciseswithmax. 10% outof total possiblepoints (30%+30%+30%+10%). Final grade isformedinthefollowingway:							weeks of students nal inalexam, ercises. o, olepoints
	Percentage Grade							

	50% to 61% sufficient (2) 62% to 74% good (3) 75% to 87% verygood (4) 88% to 100% excellent (5)							
Required literature (available in the	Title	Number of copies in the library	Availability via other media					
media)	 T Papić, V.: Introduction to computergraphics, Facultytextbook, 2013. (in Croatian) 		e-learning portal					
Optional literature (at the time of submission of study programme proposal)	 J.D.Foley, A.Dam, S.K.Feiner, J.F.Hughes, Comp PrinciplesandPractice (secondeditionin C), Addiso Company, 1996. D.Hearn, M.P.Baker, Computer Graphics, C Vers 1996. F.S.Hill, Jr. i S.M. Kelley, Computer GraphicsUsin Pearson education, 2007. Shreiner, D., Woo, M., Neider, J., Davis, T., Open Kompjuter biblioteka, 2007. 	J.D.Foley, A.Dam, S.K.Feiner, J.F.Hughes, Computer Graphics: PrinciplesandPractice (secondeditionin C), Addison-WesleyPublishing Company, 1996. D.Hearn, M.P.Baker, Computer Graphics, C Version, Prentice Hall; 2nd edition 1996. F.S.Hill, Jr. i S.M. Kelley, Computer GraphicsUsingOpenGL, 3rd edition, Pearson education, 2007. Shreiner, D., Woo, M., Neider, J., Davis, T., OpenGL vodič za programere,						
Quality assurance methods that ensure the acquisition of exit competences	 Evaluation of results in accordance with the abov Feedback from students via surveys Self-evaluation of teachers Institutional and non-institutional evaluations 	e learning out	comes					
Other (as the proposer wishes to add)								

NAME OF THE COURSE											
Code	ELG32 Year of study 1.										
Course teacher	Mojmil Cecić, Ph.D., Full Professor Josip Musić, Ph.D., Assistant Professor	Credits (ECTS)	5								
	Tea Marasović, Ph.D., Type of instruction		L	S	AE	LE	DE				
Associate teachers	Assistant Professor	(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	Training students for: - understanding basic pr biocybernetics.	rinciples and techniques in	the ar	ea of t	eleme	dicine	and				
Course enrolment requirements and entry competences required for the course	None										
Learning outcomes expected at the level of the course (4 to	Students will be able to: - explain computer and t	telecommunication basis for	or telen	nedicir	ne.						

10 learning outcomes)	 evaluate proper rate clinical app choose sources evaluate system analyze joint for experiment with sensors, inertial evaluate measu limitations. 	rate clinical application of telemedicine. choose sources of medical information in light of distant learning paradigm. evaluate systems for biomechanical human analysis. analyze joint forces and moments in correlation with muscle activity. experiment with measurement systems in biocybernetics based on EMG sensors, inertial sensors and optoelectronic sensors. evaluate measurement results in light of possible future application and system limitations.											
	Course content						L						
	Introduction to tolon	adiaina	Historia		lonmon	of tolomodicing	hours						
	Computer and telec		Cation ba		tolomod	icine	2						
	Computer and telecommunication basis for telemedicine.												
	Distant learning ser	arching	through s		of modi	cal information	2						
	Image processing in		dicipo	ources	ormeu		2						
Course content	Ethics and telemedi		uicine.				2						
broken down in	Clinical application	cine.					2						
detail by weekly class schedule (syllabus)	Introduction to biocy measurement of hu	ntroduction to biocybernetics; overview of technical systems for neasurement of human biomechanical parameters; measurement											
	Human anthropometric parameter identification; gait analysis:												
	Gait parameter measurements; Kinematics and kinetics; Body position and balance during gate; measuring ground reaction forces during gait.												
	Electromyography,	measuri	ng muscl	e activi	ty during	g human movement.	2						
	Inverse kinematics f	Inverse kinematics for muscle force identification.											
	Machine vision in bi	ocybern	etics.				2						
	List of laboratory or	design e	exercises				LE hours						
	Introductory lecture c	on labora	atory safe	ety proc	edures,	laboratory	2						
	measurement system	ns, and	measurer	nent pr	ocedure	es.	-						
	ivieasuring numan ar	ithropon	netric par	ameter	s using	finite element	3						
	Measuring kinematic	parame	eters durir	na aait i	using fa	st cameras.	4						
	Measuring ground re	action for	orces dur	ing gait	using fo	orce plate.	3						
	Measuring EMG mus	cle sign	als during	g gait.		•	4						
	Calculation of muscle measured kinematica with recorded EMG s	e forces al param ionals.	and morr leters and	nents du d floor r	uring ga eaction	it based on forces. Comparison	4						
	Measuring cervical s	pine ran	ge of mo	tion usi	ng inerti	al motion sensors.	3						
	Application of machir Croatian signed alph	ne visior abet.	ı in classi	fication	and au	tomatic translation of	4						
	Algorithms for image	process	sing in tel	emedic	ine.		3						
	☑ lectures			🗆 inde	enender	it assignments							
	\boxtimes seminars and wo	rkshops			timodia	a abaiginnento							
Format of instruction	exercises				rotory								
Format of Instruction	□ on line in entirety				natory	antar							
	□ partial e-learning			⊔ wor	K with m	ientor							
	☐ field work				(othe	er)							
Student	The presence on lec	tures in	the amou	unt of a	t least 7	0 % of the times sche	duled.						
responsibilities	Performed all require	ed labor	atory exe	rcises.									
	Performed all required laboratory exercises. Class attendance 1 Research Practical training												
Screening student work (name the	Class attendance	1	Research Practical training										

credits for each activity so that the	Essay		Seminar essay		Laboratory exe	ercises	1,5				
total number of ECTS credits is equal to the ECTS	Tests	0,1	Oral exam		Preparation fo 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	 weeks or lectures (in the area of biocybernetics) and the second one is after 13 of lectures (in the area of telemedicine in a form of a project assignment) midterm test (as well as the final test) is carried out in a written format with d of 90 minutes. It consists of both theoretical questions and numerical problet the final exams students that did not pass the midterm exams take part. The exam test consists of 8 theoretical questions and numerical problems requirement for passing grade is the positive assessment of laboratory exercis 50 % points on average midterm exam ((M1 + M2)/2) or the final exam. Stude allowed to have at least 45% of total points on each midterm exams, as long final midterm average is at least 50% of total points. Grade (in percentage) is formed according to the formula: Grade (in percentage) is formed according to the formula: Grade (based on percantages) is formed as follows: Percentage Grade S0% 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 participat teaching activities attending at least 70% of lectures, and 100% of lab exercises. In accordance with that student is required to solve and turn or grading 100% of all laboratory exercises. If student does not meet these criter or he won't be able to take part in the final exam, and will be required to enrored a student of the error or participation for the final exam. 										
		Title)		copies in the library	Availabi other r	lity via nedia				
	 I. Klapan, I. Čike Medika, Zagreb, 	š:; Teler <u>2001.</u>	medicina u Hrvat	skoj,	3	teac	her				
Required literature (available in the library and via other media)	 R. J. Jagacinski, Humans: Quantit Performance, La Inc., 2003 	J. M. FI ative Ap wrence	ach: Control The oproaches to Mo Erlbaum Associa	ory for deling ates		teac	her				
	T. Marasović, Guexercises, FESB	lidelines	for laboratory			e-lear por	ning tal				
	M. Cecić, J. Musić: Authorized lecture notes, FESB portal										
Optional literature (at the time of submission of study programme proposal)	1. Winter D.A.: The I Waterloo Press, Wa 2. Zanchi V., Cecić N Identification of Hum	FESBportalWinter D.A.: The Biomechanics and Motor Control of Human Gait, University of aterloo Press, Waterloo, 1991.Junchi V., Cecić M., Grujić T., Kuzmanić A., Papić V. : Laboratory for entification of Human Movement with LaBACS Software Support, International									

	Congress on Computational Bioengineering, ICCB'03, 24-26 September 2003., Zaragoza, Spain, p.p. 155-161 3.I. Kaplan, I Čikeš (editors): "Telemedicine", Telemedicine Association, Zagreb, 2005. 4. V. Štambuk: "Kibernetika s informatikom", 1989. 5. V. R. Milačić : "Tehnička kibernetika", 1981.
	6. N. Wiener: "Kibernetika ili upravljanje i komunikacija kod živih bića i mašina", 1972.
Quality assurance methods that ensure the acquisition of exit competences	 Keeping records of student attendance Annual analysis of course statistics in terms of midterm and finals exams Feedback from students via surveys teacher self evaluation Feedback from graduated students (or senior students) on course content relevance Periodic institutional evolution of course teachers
Other (as the proposer wishes to add)	/

NAME OF THE COURSE	SOLAR CELLS									
Code	FELH35	Year of study	1							
Course teacher	Tihomir Betti, Ph.D., Assistant Professor Ivan Marasović, Ph.D., Assistant Professor	Credits (ECTS)	5							
Associate teachers		Type of instruction	L	S	AE	LE	DE			
		(number of hours)	30			30				
Status of the course	Elective Percentage of application of e-learning									
	COURSE	DESCRIPTION	-							
Course objectives	 Training students for: Understanding fundam Modeling solar cells us Calculating solar radiat Understanding differen Designing simple stand Calculating the electric 	ental operating principles ing equivalent electrical ci tion on the plane of arbitra t PV technologies and con d-alone and grid-connected ity production of a photovo	of sola rcuits. ry tilt a nparisc d PV sy oltaic sy	r cells. nd orie on betv ystems ystem.	ntatio veen t	n. hem.				
Course enrolment requirements and entry competences required for the course	None.									
Learning outcomes	Students will be able to:									
expected at the level of the course (4 to	 Calculate the compone orientation 	ents of solar radiation on th	e plan	e of arl	oitrary	tilt and	d			
10 learning	 Explain the physical op 	perating principles of a sola	ar cell.							
outcomes)	 Compare different sola 	r cell technologies.								

	 Design simple gr Calculate the elements 	rid-conn ectricity	 Design simple grid-connected and stand-alone photovoltaic system. Calculate the electricity production of a photovoltaic system. 							
	Course content						L	hours		
	Introduction. Solar ra	adiation:	irradiand	ce and i	rradiatic	on. Basic solar		2		
	geometry parameter	s.						2		
	Solar radiation comp the beam, diffuse an	onents. d reflect	Measure ted solar	ement o radiatio	f solar r n.	adiation. Calculating		2		
	Physical principles o and basic solar cell p	f solar c paramet	ell opera ers. Serie	tion. Cu es and s	irrent-vo shunt re	oltage characteristic sistance.		2		
	Solar cell models. Do and temperature.	epender	nce of sol	lar cell	paramet	ers on irradiance		2		
	Amorphous silicon s	olar cell	S.					2		
	Crvstalline silicon so	lar cells						2		
	High-efficiency III-V	multijun	ction sola	ar cells.	Other s	emiconductor		2		
	Organic solar cells	<i>.</i>						2		
	Third concration cold	ar colle:	conconto	and no	reportiv	o Napostructuro		2		
Course content	based solar cells.	ai celis.	concepts	anu pe	erspectiv	ve. Nanostructure-		2		
broken down in	Photovoltaic system:	s: stand	-alone ar	nd grid-o	connect	ed. Photovoltaic				
detail by weekly class schedule (syllabus)	system components:	inverte	rs, charg	e regula	ators, ba	atteries, mounting		2		
	structures, cables.									
	Design of grid-conne	cted an	d stand-a	alone pl	notovolta	aic system. Shading		2		
	and mismatch losses	s. Hot sp	oot neatir	ng.						
	Estimation of algotric	ity prod	uction of	o photo		ovetere		2		
	DV coll module and evotom tecting. Environmental impact of a							2		
	PV Cell, module and	Photov	oltaics in	the sm	art arid	Inpact of a		Z		
	List of laboratory or o	design e	vercises		art griu.		IF	hours		
	Solar radiation. Measurement of solar radiation.							3		
	Calculating global horizontal radiation from sunshine duration							3		
	Estimation of solar radiation on surface of arbitrary tilt and orientation.							6		
	Shade measurement	and sol	ar site as	sessm	ent.			3		
	Design of grid-conne	cted pho	otovoltaic	system	า.			6		
	Estimating electricity	product	ion of a p	hotovo	ltaic sys	tem.		3		
	Visiting photovoltaic	system of	on the roo	of of the	e faculty	building.		3		
	Testing photovoltaic modules and systems. Photovoltaic system in the							3		
	\Box seminars and wor	kshops		🛛 inde	epender	nt assignments				
		Renope		🛛 multimedia						
Format of instruction	\Box on line in entirety			⊠ laboratory						
	\Box partial e-learning			□ wor	k with m	nentor				
	\boxtimes field work				(othe	r)				
Studentresponsibiliti	At least 70% of lectu	res atte	ndance	l Comple	ted all l	aboratory assignment	s ar	nd the		
es	presentation of two p	orojects.		Comple			5 01			
Screening student work (name the	Class attendance	1	Researc	h		Practical training				
proportion of ECTS	Experimental work		Report			Individual work		2		
eachactivity so that	Essay		Seminai essay	r		Laboratory exercises	;	1		
ECTS credits is	Tests	0.15	Oral exa	am		(Other)				
equal to the ECIS value of the course)	Written exam	0.1	Project		0.75	(Other)				
Grading and evaluating student	Students work in gro of global solar radiati calculation of solar e	oups of t on from nergy o	wo on tw sunshine n slope o	/o proje e duratio f arbitra	cts: the on, the e ary tilt ar	first project involves of evaluation of the mode and orientation. The first	calc I us t pro	ulation ed and oject is		

work in class and at the final exam	 presented during the first midterm exam (after 7 w project is design of a photovoltaic system and student the results during the second midterm exam (after the Apart from presentation of student projects, there will requirement for passing the course is to score at lea all laboratory work and successfully present the percentage) is formed using following formula: Grade(%)=0.3(M1+M2)+0.4P, where: M1, M2 – grade from midterm exams given in ercentage. Students notpassingthemidtermexams take passingthefinalexam, students must score at lea positiveassesmentofthelaboratoryexercises. finalexamsisdeterminedbythe formula: Brade(%) = 0.65F+0.35 	reeks of class ts must comple e following 6 w Il be two midte st 40% at eac projects The percentage, partinthefin st 50% as w The g P,	es). The second ete it and present eeks of classes). erm quizzes. The h quiz, complete final grade (in alexams. For well as have a grade on
	Title	Number of copies in the library	Availability via other media
Required literature (available in the library and via other media)	 T. Betti, I. Marasović: Sunčanećelije – autoriziranapredavanja (prezentacije), FESB P. Kulišić, J. Vuletin, I. Zulim: Sunčane ćelije, Školska knjiga, Zagreb, 1994. PlanningandInstallingPhotovoltaic Systems, 2nd edition, Earthscan, 2010. 		E-learning portal
Optional literature (at the time of submission of study programme proposal)	 T. Markvart, L. Castañer: Practical Handbook of I and Applications, Elsevier, 2003. M.A. Green: Solar cells: operating principles, tech applications, Prentice-Hall, 1982. A. Luque, S. Hegedus: Handbook of Photovoltaic Wiley, 2003. S.M. Sze, K.K. Ng: Physics of Semiconductor De M.A. Green: Third Generation Photovoltaics, Spri 	Photovoltaics: nnology, and s Science and vices, Wiley, 2 inger, 2006.	Fundamentals ystem Engineering, 2006.
Quality assurance methods that ensure the acquisition of exit competences Other (as the proposer wishes to add)	 Record of number of students attending the class Evaluation of results in accordance with expected Feedback from students via student surveys Teachers self-evaluation Institutional and non-institutional evaluations 	ses d learning outc	omes

NAME OF THE COURSE	OPTOELECTRONIC MEASUREMENT METHODS							
Code	FELG33	Year of study	1					
Course teacher	Ivo Stančić, Ph.D., Assistant Professor	Credits (ECTS)	5					
		Type of instruction	L	S	AE	LE	DE	
Associate teachers		(number of hours)	30			30		
Status of the course	Elective	Elective Percentage of application of e-learning 0						
	COURSI	DESCRIPTION	•					
Course objectives	Training students for: - Understand the basic p - Operate with linear, IR - Apply camera to contro - Operate and analyze da	rinciples of camera and op / night and heat cameras I industrial process or use ata from laser range finder	otical ler it as a s s and L	ns eler sensor IDAR	ments			
Course enrolment requirements and entry competences required for the course								
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: Have detail knowledge of camera and camera optical elements Apply algorithms for 3D reconstruction of motion Apply algorithm for surface reconstruction Analyze data from laser range finders and create map of area 							
	Course content					/ bc	١E	
	Introduction to optoelectronics							
	Introduction to optoelectron	nics			2		ours	
	Introduction to optoelectron Machinevisionaandcomput	nics ervision			2 2 2		ours	
	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionof	nics ervision camerasandgeometryof a s	space		2 2 4		ours	
	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionof Lenseoptical system anddi	nics ervision camerasandgeometryof a storsions	space		2 2 4 2		ours	
	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen	nics ervision camerasandgeometryof a storsions sitivechips	space		2 2 4 2 2 2		ours	
	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionof Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca	nics ervision camerasandgeometryof a storsions isitivechips ameras, motioncapturesyst	space		2 2 4 2 2 2 2 2 2		ours	
	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionof Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst	space		2 2 4 2 2 2 2 2 2 2		ours	
	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems	nics ervision camerasandgeometryof a storsions usitivechips ameras, motioncapturesyst	space		2 2 4 2 2 2 2 2 2 2 2 2			
	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners	nics ervision camerasandgeometryof a storsions isitivechips ameras, motioncapturesyst	space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2			
Course content	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s	space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2			
Course content broken down in	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s AR AR	space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			
Course content broken down in detail by weekly	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future of optoelectronics	nics ervision camerasandgeometryof a storsions isitivechips ameras, motioncapturesyst s AR AR ageintensifiers	space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			
Course content broken down in detail by weekly class schedule	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics	nics ervision camerasandgeometryof a storsions isitivechips ameras, motioncapturesyst s AR AR ageintensifiers	space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2			
Course content broken down in detail by weekly class schedule (syllabus)	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics Introduction to optoelectron	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s AR ageintensifiers nics exercises	space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		-E -E 	
Course content broken down in detail by weekly class schedule (syllabus)	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics Introduction to optoelectron List oflaboratoryor design e	nics ervision camerasandgeometryof a storsions isitivechips ameras, motioncapturesyst s AR ageintensifiers nics exercises ge loading, capture and ed	space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		E 2	
Course content broken down in detail by weekly class schedule (syllabus)	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics Introduction to optoelectron List oflaboratoryor design of Introduction to Matlab: image	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s AR ageintensifiers nics exercises ge loading, capture and ed o loading, capture and edi	space tems		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		LE DUITS 2 2	
Course content broken down in detail by weekly class schedule (syllabus)	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics Introduction to optoelectron List oflaboratoryor design of Introduction to Matlab: imag Introduction to Matlab: imag	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s AR ageintensifiers nics exercises ge loading, capture and ed o loading, capture and edi tortion removal	space tems		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		E DUITS 2 2 2 2	
Course content broken down in detail by weekly class schedule (syllabus)	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics Introduction to optoelectron List oflaboratoryor design of Introduction to Matlab: imag Introduction to Matlab: vide Camera calibration and dist Movement reconstruction fr	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s AR ageintensifiers nics exercises ge loading, capture and edi tortion removal com single camera in single	space tems liting ting e plane		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		E Durs 2 2 2 2	
Course content broken down in detail by weekly class schedule (syllabus)	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics Introduction to optoelectron List oflaboratoryor design of Introduction to Matlab: imag Introduction to Matlab: imag Introduction to Matlab: vide Camera calibration and dist Movement reconstruction fr	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s AR ageintensifiers nics exercises ge loading, capture and edi tortion removal form single camera in single vith stereovision system in	space tems liting ting e plane space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		E Durs 2 2 2 2 2 2	
Course content broken down in detail by weekly class schedule (syllabus)	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics Introduction to optoelectron List oflaboratoryor design of Introduction to Matlab: imag Introduction to Matlab: imag Introduction to Matlab: vide Camera calibration and dist Movement reconstruction fr Movement reconstruction fr	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s AR ageintensifiers nics exercises ge loading, capture and ed o loading, capture and ed tortion removal om single camera in single /ith stereovision system in	space tems liting ting e plane space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		E DUITS 2 2 2 2 2 2 2 2 2 2 2 2	
Course content broken down in detail by weekly class schedule (syllabus)	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics Introduction to optoelectron List oflaboratoryor design of Introduction to Matlab: imag Introduction to Matlab: imag Introduction to Matlab: imag Introduction to Matlab: imag Introduction to Matlab: optie Camera calibration and dist Movement reconstruction fr Movement reconstruction fr Movement reconstruction fr SD scanners and surface re-	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s AR ageintensifiers nics exercises ge loading, capture and ed o loading, capture and ed tortion removal com single camera in single vith stereovision system in econstruction	space tems liting ting e plane space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		E DUITS 2 2 2 2 2 2 2 2 2 2 2 2 2	
Course content broken down in detail by weekly class schedule (syllabus)	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics Introduction to optoelectron List oflaboratoryor design of Introduction to Matlab: imag Introduction to Matlab: imag Introduction to Matlab: imag Introduction to Matlab: vide Camera calibration and dist Movement reconstruction fr Movement reconstruction w Laser and IR rangefinders 3D scanners and surface re Lidar and applications in ro Cameras in visible and IP of	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s AR ageintensifiers nics exercises ge loading, capture and edi tortion removal com single camera in single vith stereovision system in econstruction botics	space tems liting ting e plane space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		LE DUITS 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	
Course content broken down in detail by weekly class schedule (syllabus)	Introduction to optoelectron Machinevisionaandcomput Mathematicaldescriptionofo Lenseoptical system anddi Color system andphotosen Inudstrialcameras, linearca IR camerasandapplications Stereovisionsystems 3D scanners Laser rangefindersand LID Nightvisioncamerasandima Future ofoptoelectronics Introduction to optoelectron List oflaboratoryor design of Introduction to Matlab: imag Introduction to Matlab: imag Introduction to Matlab: imag Introduction to Matlab: vide Camera calibration and dist Movement reconstruction fr Movement reconstruction fr Movement reconstruction w Laser and IR rangefinders 3D scanners and surface re Lidar and applications in ro Cameras in visible and IR s IR thermal camera and tem	nics ervision camerasandgeometryof a storsions sitivechips ameras, motioncapturesyst s AR ageintensifiers nics exercises ge loading, capture and edi tortion removal on single camera in single with stereovision system in econstruction botics spectrum. Presentation of r	space tems liting ting e plane space		2 2 4 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2		E DUITS 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	

Format of instruction	□lectures ⊠independent □seminars and workshops ⊠multimedia □exercises ⊠laboratory □on linein entirety □work with me □partial e-learning □ (other)				t assignments entor r)			
Studentresponsibiliti es								
Screening student	Class attendance	1	Researc	h		Practical traini	ng	
proportion of ECTS	Experimental work		Report			Impended rese	earch	1,7
eachactivity so that	Essay		Seminai essay	•	1	Laboratory exe	ercises	1
ECTS credits is	Tests	0,2	Oral exa	ım		(Other)		
equal to the ECTS value of the course)	Written exam	0,1	Project			(Other)		
	During the semester project assignments	there a will be l	re two mi handed o	dterm e ut depe	xams a ending o	ccording to tead	ching cale erences.	ndar or
	The requirement for and 50 % points on a are allowed to have the final midterm ave	passing average at least erage is	grade is midterm 45% of to at least 5	the posi exam ((otal poil 50% of t	itive ass (M1 + M nts on e total poi	essment of lab 2)/2) or the fina ach midterm e nts.	oratory ex I exam. Si xams, as	ercises tudents long as
	Nidterm consists of both theoretical questions and numerical problems. The midterms consist of 4 questions while final exam test consists of 6 questions divided into two groups.							
Grading and evaluating student work in class and at	In determining the final grade (in percentages) each midterm contributes with 30% (or project assignment with 60%), while laboratory exercises contribute with 40%.							
the final exam	Final grade (based on percentages) is formed as follows:							
	Percentage Grade 50% do 62% sufficient (2) 53% do 74% good (3) 75% do 86% very good (4) 37% do 100% excellent (5)							
	In case student does the final exam in white exercises again with	s not coi ch case 40%.	mplete m it contribu	idterms ites with	or proje n 60% to	ect exams he/s oward final grad	he needs le, and lab	to take oratory
Required literature		Title	•			Number of copies in the library	Availabi other n	lity via nedia
(available in the library and via other media)	 Hartley, R., Zisse 'Multipleviewgeo (Cambridge Univ 	erman, A metryino rersity P	4.: computer ress, 200	vision' 3)				
	• Shapiro, G., Stoo (Prentice-Hall, 20	kman, ()01)	G.C.: 'Co	mputer	vision'			
Optional literature (at the time of submission of study programme proposal)								
Quality assurance methods that ensure the acquisition of exit competences	 Keeping records Annual analysis Feedback from s Teacher self-eva 	of stude of cours tudents luation.	ent attend e statistic via surve	lance. s in ter eys.	ms of m	idterm and fina	ils exams.	

	- Feedback from graduated students (or senior students) on course content relevance.
Other (as the proposer wishes to add)	/

NAME OF THE COURSE	OPTIMIZATION AND OP	TIMAL SYSTEMS					
Code	FELG23	Year of study	2.				
Course teacher	Mirjana Bonković, Ph.D., FullProfessor	Credits (ECTS)	5				
Associate teachers		Type of instruction	L	S	AE	LE	DE
			30	0	0	30	0
Status of the course	Obligatory	Percentage of application of e-learning	0				
	COURSI	E DESCRIPTION					
Course objectives	Training students for adoptionandunderstanding solvingproblemsinthefields productionplanningand / or	ofthebasicknowledgeof:op ofengineering, such as rot ranalysis (understanding) t	timizat oot con heimag	ionpro trol, geconte	cedure ent.	es for	
Course enrolment requirements and entry competences required for the course							
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: Applyoptimizationmeth model, defininganoptin exploringthesolutionan Understandandapplyur includingthenecessary Newton'smethod, conju Understandbasictheore Understandandapplydi exhaustivesearchands Understandandapplyth solvinglinearproblemsy Have some familiarityy 	nods to engineeringproblem nization problem, applying idinterpretingresults. nconstrainedoptimizationth andsufficientconditionsanc ugategradientandquasi-Ne emsofquasi-Newton metho iscretealgorithms, including imulatedannealing. nesimplexalgorithm for withconstraints. vithoptimization software.	ns, incl optimiz leory fo lsteepe wton n ods. gbrancl	udingd ationm or conti estdesc nethod nandbo	evelop nethod nuous cent, s. bund,	bing a s, proble	ems,
	Course content					Lh	ours
	Introduction Modelsofengi	neeringoptimization				AE	2
Course content	Mathematicalmodeling. Ob	piectivefunction.				-	2
broken down in	Performanceoffeedbackco	, ntrol system.				1	4
detail by weekly	Optimizationwithoutconstra	aints. Gradientmethod. Nev	wton'sr	nethoc			4
(svllabus)	Discreteoptimization. Simu	latedannealing. Genetical	gorithm	IS.		1	4
	Optimizationwithconstraint	s. Linearprogramming. Sin	nplexal	gorithr	n.		4
	Non-linearoptimizationwith	constraints.					4
	Thecalculusofvariations.						2

	Casestudies: Applica	ationofn	onlinearo	ptimiza	tionmet	hods for		2
	Analysisand process	ing ofme	edicalima	des .				6
		ing on	Guidanna	900.			I	U
		kehone		⊠inde	penden	t assignments		
		KSHOPS		⊠mult	imedia			
Format of instruction				□labo	ratory			
T Office of mole doller	<i>□ on line</i> in entirety			⊠work	with m	entor		
	□partial e-learning				(othe	r)		
	□field work				(0110	1)		
Studentresponsibiliti es								
Screening student	Class attendance	2	Researc	h		Practical training	ng	
proportion of ECTS	Experimental work		Report			Individual work	(1
eachactivity so that	Essay		Seminai essay	•		Laboratory exe	ercises	0
ECTS credits is equal to the ECTS	Tests	0,3	Oral exa	ım		Preparation for laboratory exe	r rcises	0
value of the course)	Written exam	0,3	Project		1,4	(Other)		
Grading and evaluating student work in class and at the final exam	addressed. In addition 7 weeks of lectures presentation and det the final test) is can requirement for pass points on average in allowed to have at lea final midterm average Grade (in percentage Grade (%) = 0,5M1 + where: • M1, M2 – mi It is possible to be re project tasks. According to Article teaching activities a exercises. If student in the final exam, an	on, there and the fense of rried out sing grad midterm east 45% je is at lo e) is forn - 0,5M2 idterm to lieved of 65. of l attending does no d will be	e are two e second f the project t in a wr de is the exam ((% of total east 50% med accord est results f the midt Faculty's g at lease of meet th e requirec	midtern one is a ect assi itten for positive M1 + N points o of total ording to s. erm exa Bylaw, st 70% ese crit	n exams after 13 gnment rmat wi e assess M2)/2) c on each I points. o the for of the for studen of lect eria, sho oll in the	s. The first midte weeks of lectu). Each midtern th duration of 9 sment of project or the final exa midterm exam mula: ase of making e t is required to cures, and 100 e or he won't be course the new	erm exa ires (in a n test (a 90 minu t tasks a m. Stuc s, as lou extensiv particip % of la able to kt year.	m is after a form of is well as ites. The and 50 % lents are ng as the ag as the ate in all aboratory take part
		Title	•			copies in	Availa other	bility via [·] media
		-				the library		
Required literature	D. Pierre, Optimizati	onTheo	ryWithAp	plicatio	ns,		e-learn	ing
(available in the	John Willey&Sons, N	New Yor	k, 1969.					
library and via other media)	M. Bonković: Autoriz	zirana pr	redavanja	a, FESB	3		e-learn	ing
,	http://apmonitor.com	n/me575	/index.ph	p/Main	/BookC			
	hapters (10.03.2017)						
	V. Zanchi, Optimizad	. <i>)</i> cija, Sve	učilište u	Splitu,	1983.		e-learn	ing
Optional literature	- Kamran loubal: F	Jundam	ental Enc	ineerin	a Optim	ization Methods	s	
(at the time of	bookboon com (19 03 20)17)		5 - Puill		- 1	
submission of study	Numerical Regin	oo in C	$(or C \cup 1)$. Tha A	rt of Soi	ontifia Computi	na huV	/illiam Ll
programme				. I ne A			ng, by v	
proposal)	Press, Brian P. Flannery, Saul A. Teukolsky, William T. Vetterling.							

	 Convex Optimization, Stephen Boyd & Lieven Vandenberghe, 2004 Stephen Boyd on Convex Optimizations pdfs video lectures
Quality assurance methods that ensure the acquisition of exit competences	 Keeping records of student attendance. Annual analysis of course statistics in terms of midterm and finals exams. Feedback from students via surveys. Teacher self-evaluation. Feedback from graduated students (or senior students) on course content relevance. Periodic institutional evolution of course teachers.
Other (as the proposer wishes to add)	

NAME OF THE COURSE	MICROCONTROLLERS AND NETWORK EMBEDDED SYSTEMS									
Code	FELG24	Year of study	2.	2.						
Course teacher	Mirjana Bonković, Ph.D., FullProfessor	Credits (ECTS)	5							
Associate teachers	Ivo Stančić, Ph.D., AssistantProfessor	Type of instruction (number of hours)	Type of instructionLSAE(number of hours)3000							
Status of the course	Obligatory	Percentage of application of e-learning	0							
	COURSE	DESCRIPTION								
Course objectives	 Training students: to develop an understate embedded systems to develop an understate to be familiar with concellate of the able to create eminetwork and the Internet. 	Training students: to develop an understanding for the purpose and the design principles of the embedded systems to develop an understanding of basic microcontroller architecture to be familiar with concept of microcontroller interfaces to be able to create embedded system that communicates via a local Ethernet								
Course enrolment requirements and entry competences required for the course	Finished programming course	Finished programming course.								
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: define and understand the embedded system. define and understand program the related mi appropriate functionalit design the embedded s functionality based on s apply a procedure that processing unit apply a procedure whic through web interface. 	Students will be able to: define and understand the basic concepts related to the process of designing the embedded system. define and understand the interfacing techniques program the related microcontrollers' peripheral systems to establish the appropriate functionality of the embedded system design the embedded system in the Arduino environment that reflect the functionality based on the information processing acquired from the sensors. apply a procedure that provides network data transmission from sensor to the processing unit apply a procedure which ensures the functionality of the embedded system								
Course content broken down in	Course content					hc	Lours			
detail by weekly	The purpose of a microcon	troller. Embedded system	design	n prin <mark>c</mark> i	ples.		2			

	Early the terror terror to Arth Second states						0	
class schedule	Empedded system d	lesign in	Arduno	enviror	iment.	· · · ·	Ż	
(Syllabus)	Knowledge and under	erstandi	ng of fun	dament	al embe	edded systems	n	
	design paradigms, a		ures, pos	SIDIIITIEs	s and cri	allenges, both	2	
	Microprocessor perir	ale allu	naruwar Iowicos G	<u>e.</u> `oporal		s input output	2	
	Microprocessor perip				puipose	e Input output.	<u>ک</u>	
	Serial communicatio	n: 5ri, i	USARI, I	IC.			4	
	Real time clock. Tim	ceal time clock. Timers.						
	A / D and D / A conv	erters. I	Realizatio	n of A	/ D conv	verters.	2	
	Interrupts. Programn	errupts. Programming interrupts.						
	Architecture and function.	chitecture and functional microprocessors' components for network						
	Using IP for local and	d Intern	et commi	unicatio	ns. Exc	hanging messages	2	
	Using the Web interf	ace.		yətern.			2	
	Optimization of the e	mbedde	ed systen	n regard	ding the	energy	2	
	Consumption	dooign (woroiene				Eboure	
	Introduction to the Ar	duino d	<u>Avelopm</u>	ont envi	ronmen	t: hardware	LEHUUIS	
	componentsandprog	rammin	a mode.	SIL CIVI	IUIIIIeii	I. Haiuwaie	2	
	Digital input - output.	Serial N	Monitor.				2	
	Analog input, PWM c	utout.					2	
	Speedcontrolof DC m	notors.					2	
	Using GPS module.						2	
	Using NRF modules.						2	
	Sensors: OneWire te	mperati	ure senso	vr analo	asenso	r (avroscope), IIC	-	
	sensor.	mporace		", ana	9301.00		2	
	Ethernet shild. Excha	angingm	iessagesi	using U	DP and	TCP.	2	
	Web server (withand	withoutf	eedback)	, e-mai	l, alarm	system.	2	
	Optimization of the er	mbedde	d system	regard	ling the	energy consumption	2	
	Student projects.						6	
	⊠ lectures				- 	t occionments		
	\Box seminars and wor	rkshops		⊠ mul	timedia	it doorgrintente		
Format of instruction	⊠ exercises			⊠ labo	vratory			
Fumat or motion	□ on line in entirety			⊠ wor	k with m	pentor		
	□ partial e-learning				(othe	r)		
	☐ field work				(0	·)		
Studentresponsibiliti								
		-	Τ_		 _			
Screening student work (name the	Class attendance	2	Researc	;h		Practical training	_	
proportion of ECTS credits for	Experimental work		Report			Individual work	0,6	
eachactivity so that	Essay		essay		1	Laboratory exercises	0,8	
ECTS credits is	Tests	0,2	Oral exa	ım		Preparation for laboratory exercises	0,2	
value of the course)	Written exam	0,2	Project			(Other)		
Grading and evaluating student work in class and at the final exam	During the semester weeks of lectures and presentation and def the final test) is car requirement for pass 50 % points on avera allowed to have at le final midterm averag	there a nd the s fense of ried out sing grac age midt east 45% je is at lu	re two mi second o i the proje t in a wr de is the p term exar 6 of total east 50%	dterm e ne is a ect assi itten for ositive n ((M1 points o of total	xams. T fter 13 gnment rmat wit assessr + M2)/2 on each I points.	The first midterm exan weeks of lectures (in). Each midterm test (th duration of 90 min ment of laboratory exe) or the final exam. Stu midterm exams, as lo	n is after 7 a form of as well as jutes. The rcises and udents are ong as the	

	Grade (in percentage) is formed according to the formula:			
	Grade(%) = 0,1L + 0,4M1 + 0,5M2	$f_{0}) = 0.1L + 0.4M1 + 0.5M2$		
	where: L – laboratory assessment, M1, M2 – midterm test results.			
	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. If student does not meet these criteria, she 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	
	Steven F. Barrett, Arduino Microcontroller Processing for Everyone!, SynthesisLectures on Digital Circuitsand Systems, Morgan &ClaypoolPublishers, 2010.			
	David Russeell, Introduction to Embedded Systems Using ANSI C andthe Arduino Development Environment, SynthesisLectures on Digital Circuitsand Systems, Morgan &ClaypoolPublishers, 2010.			
	Michael Predko, HandbookofMicrocontrollers,			
	M. Bonković, J. Musić, I. Stančić, Mikroregulatori i ugradbeni mrežni sustavi, FESB, 2014.		e-learning	
Optional literature (at the time of submission of study programme proposal)	 Claus Kuhnel, Klaus Zahnert, BASIC Stamp : An Introduction to Microcontrollers, Newnes, 2000. Han-Way Huang, PIC Microcontroller, Thomson Delmar Learning, 2004. Jan Axelson: Embedded Ethernet and Internet complete, Lakeview Research LLC, 2003., ISBN: 1-931448-00-0 Microcontroller links http://people.westminstercollege.edu/faculty/rerickson/control/stamplinks.html 			
Quality assurance methods that ensure the acquisition of exit competences	 Keeping records of student attendance. Annual analysis of course statistics in terms of midterm and finals exams. Feedback from students via surveys. Teacher self-evaluation. Feedback from graduated students (or senior students) on course content relevance. Periodic institutional evolution of course teachers. 			
Other (as the proposer wishes to add)				