

UNIVERSITYOFSPLIT

FACULTY OF ELECTRICAL ENGINEERING, MECHANICAL ENGINEERING AND NAVAL ARCHITECTURE

DETAILED PROPOSAL OF THE STUDY PROGRAMME

GRADUATE UNIVERSITY STUDY IN INFORMATION AND COMMUNICATION TECHNOLOGY

SPLIT, February 2022

1.1. List ofmandatory and elective courses

Studyprogramme module: WIRELESS COMMUNICATIONS - 241

	List ofcourses									
Year of study	:1.									
Semester:I.	Semester:I.									
0747110	0005	0011005	НО	URS I	N SEI	MEST	ER*	готе		
STATUS CODE COURSE			L	S	AE	LE	DE	ECIS		
	FELJ01	Digital telecommunications	45	0	15	15	0	6		
Mandatory	FELJ28	Radars	30	0	0	30	0	5		
	* L = lecture	es, S = seminars, AE = auditoryexcercise, LE = labora	atoryex	cercise	, DE =	design	excerci	se		

	List ofcourses										
Year of study:1.											
Semester:II.	Semester:II.										
OTATUO	CODE		HO	URS I	N SEN	NEST	ER*	готе			
STATUS	CODE	CODE COORSE		S	AE	LE	DE	ECIS			
	FELJ24	Bioelectromagnetics	30	0	0	30	0	5			
Mandatory	FELJ33	Antennas	30	0	15	15	0	6			
	* L = lectures	, S = seminars, AE = auditoryexcercise, LE = labora	atoryexc	cercise	DE =	design	excerci	se			

	List ofcourses										
Year of study	Year of study:2.										
Semester:III.	Semester:III.										
OTATUO			НО	URS I	N SEI	NEST	ER*	FOTO			
STATUS	CODE	COURSE	L	S	AE	LE	DE	ECIS			
	FELH25	Electromagnetic compatibility	45	0	15	15	0	6			
	FELJ26	Electromagnetic ecology and dosimetry	30	0	0	15	0	4			
Mandatory	FELJ22	Measurements in wireless systems	30	0	15	15	0	5			
	FELJ36	Systems for wireless transmission of energy	30	0	0	30	0	5			
FELH18Medical devices30030								5			
	* L = lectures, S = seminars, AE = auditoryexcercise, LE = laboratoryexcercise, DE = design excercise										

Studyprogramme module:: TELECOMMUNICATIONS AND INFORMATICS - 242

List ofcourses									
Year of study:1.									
Semester:I.									
OTATUO	0005	CODE COURSE		HOURS IN SEMESTER*					
STATUS	CODE			S	AE	LE	DE	ECIS	
	FELJ01	Digital telecommunications	45	0	15	15	0	6	
Mandatory	FELJ28	Radars	30	0	0	30	0	5	
	FELJ02	Radio communications	30	0	15	15	0	5	
* L = lectures, S = seminars, AE = auditoryexcercise, LE = laboratoryexcercise, DE = design excercise									

	List ofcourses										
Year of study:1.											
Semester:II.	Semester:II.										
STATUS	CODE	COURSE	HO	FOTO							
			L	S	AE	LE	DE	ECIS			
	FELJ12	Algorithms	30	0	15	15	0	5			
	FELJ14	Mobile communications	30	0	15	15	0	5			
	* L = lectures, S = seminars, AE = auditoryexcercise, LE = laboratoryexcercise, DE = design excercise										

List of courses											
Year of study:2.											
Semester:III.	Semester:III.										
					N SEN	NEST	ER*	FOTO			
STATUS	CODE COURSE	L	S	AE	LE	DE	ECIS				
	FELH30	Local and access networks	30	0	0	30	0	5			
Mandatany	FELJ24	Bioelectromagnetics	30	0	0	30	0	5			
Mandatory	FELH18	Medical devices	30	0	0	30	0	5			
	FELJ20	Multimedia systems	30	0	0	30	0	5			
	FELJ22	Measurements in wireless systems	30	0	15	15	0	5			
Elective	FELJ36	Systems for wireless transmission of energy	30	0	0	30	0	5			
	* L = lectur	es, S = seminars, AE = auditoryexcercise, LE = labora	atoryexo	cercise	, DE =	design	excerci	se			

1.2. Course description

NAME OF THE COURSE	DIGITAL TELECOMMUNICATIONS										
Code	FELJ01	Year of study	1.								
Course teacher	Joško Radić, Ph.D., Associate Professor	Credits (ECTS)	6								
Associate teachers	Petar Šolić, Ph.D., Assistant Professor	Type of instruction (number of hours)	L 45	S 0	AE 15	LE 15	DE 0				
Status of the course	Obligatory	Percentage of application of e-learning	0								
	COURSE	DESCRIPTION									
Course objectives	 Training students for: Understanding the structure of a digital communication system Application of analytical models necessary to understand the effects and the design of digital communication systems Implement and analyse a simple communication system Acquiring knowledge about the ways of realization of communication networks 										
Course enrolment requirements and entry competences required for the course	None	one									
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: Compare different systems with redundant coding Analyze the properties of communication systems with redundant coding applied Design transceiver filters for transmission without ISI Explanation of the role of synchronization in a digital communication system Select the corresponding ARQ system with respect to the parameters of the communication channel Identify the topology of the communication network and describe ways of switching in the network 										
	Course content			ł	L nours	A ho	NE ours				
	Real channelsEqualisation				3		2				
	Nyquistfilters, correlationfilt	ters,			3		2				
	Linearandnon-linearequaliz	zation, Nyquistsignalingfilte	ers,		3		2				
	Echocancellation, scrambli	ng,			3		2				
Course content	Parallelandserial, synchron simplexandduplextransmis	iousandasynchronous, sion,			3		2				
broken down in detail by weekly	Synchronizationofdigitalsig	nals (clock, theframeandc	arrier)		3		2				
class schedule	Redundantcoding, block, c	onvolutionsandtrelliscodes	s,		3		2				
(syllabus)	First midterm exam										
BCH and Reed-Solomon codes, turbo coding											
	ARQ system, FEC systems	s, encryptionandprotocols,			3		2				
	Thetopologyofthe network.	networkinggroupsandsign	aling		3		2				
	Routingandnumbering plan, typesofswitchingsystems				3		2				
	Circuitswitching, multistage	eswitching			3		2				
	Spatialandtemporalswitchir	ng			3		2				

	Second midterm exa	m							
	List of laboratory exe	ercises						LE hours	
	Eye pattern							2	
	Equalisation							2	
	Scrembling							2	
	Channel coding: Bloc	ck codes	3					2	
	Channel coding: Con	volution	al codes					2	
	Optimum receiver							2	
Format of instruction	 ☑ lectures ☑ seminars and wor ☑ exercises ☑ on line in entirety ☑ partial e-learning ☑ field work 	kshops		□ inde □ mul ⊠ labo □ wor □	ependen timedia oratory k with m (othe	t assignmer nentor r)	nts		
Studentresponsibiliti es	The presence on lec Performed all require	e presence on lectures in the amount of at least 70 % of the times scheo rformed all required laboratory exercises.							
Screening student	Class attendance	1,8	Researc	h		Practical tra	Practical training		
proportion of ECTS Experimental work Report Ir				Individual w	Individual work				
credits for eachactivity so that	Essay		Seminar essay			Laboratory	3 0,5		
ECTS credits is equal to the ECTS	Tests	0,1	Oral exa	im		Preparation laboratory e	n for exercises	0,5	
value of the course)	Written exam	0,1	Project			(Oth	er)		
Grading and evaluating student work in class and at the final exam	During the semester final exams consist of pass the midterm ex The midterm and fir passing grade is the each midterm exam the formula: Grade (%) = 0,8 * (0 M1, M2 - points at the laboratory (with com The final evaluation percentage Rating 50% to 61% is suffic 62% to 74% good (3) 75% to 87% of very 88% 100% Excellent	During the semester there are two mid-term exams and the final exam. Mid-term and inal exams consist of questions and tasks. In the final exams students that did not bass the midterm exams take part. The midterm and final exams are carried out as written tests. The requirement for bassing grade is the positive assessment of laboratory exercises and 50 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula: Grade (%) = $0.8 * (0.5 * M1 + 0.5 * M2) + 0.2 * L$; V1, M2 - points at the mid-term expressed as a percentage, and L - points from the aboratory (with completed all lab. Exercises) expressed as a percentage. The final evaluation is determined as follows: Dercentage Rating 50% to 61% is sufficient (2) 62% to 74% good (3) 75% to 87% of very good (4)							
Required literature		Title	•			Number of copies in the librar	of Avai n oth	ability via er media	
(available in the	J. Proakis: Digita	I Comm	unication	, IV. Ed	l				
library and via other media)	S. Benedetto: Pri with wireless app	ncipleso	ofdigitaltra	ansmiss	sion:				
	L. W. Couch II: D Communication S	igital ar Systems	nd Analog S						

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

NAME OF THE COURSE	RADARS							
Code	FELJ28	Year of study	1					
Course teacher	Zoran Blažević, Ph.D., Full Professor	Credits (ECTS)	5					
Associate teachers	Maja Škiljo, Ph.D.	Type of instruction (number of hours)	L 30	S 0	LE 30	DE 0		
Status of the course	Elective	Percentage of application of e-learning	0					
	COURSE	DESCRIPTION	•					
Course objectives	 explaining and increasing the knowledge about radiolocation principles, radar operation principle, and the role of all main radar subsystems. calculating and estimating the basic radar signal parameters differentiating between specific radar types and perceiving their advantages and disadvantages visualization of possibilities and characteristics of surveillance and targeting radar operation considering and investigating modern solutions in radar technology 							
Course enrolment requirements and entry competences required for the course	Finished the undergraduate	e study of Communication	s and I	nforma	ation T	echno	logy	
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: develop competencies in individual and team work in analyzing and designing certain radar subsystems estimate and calculate radar target parameters recognize the relation between certain tactical and technical radar requirements evaluate and perceive advantages and disadvantages of certain radar types consider and analyze characteristics of surveillance and targeting radars 							
	Course content					Lh	ours	

	Introduction to rada	r systen	าร.				1			
	Basic principles of r	adar sy	stems.				2			
	Parameters of rada	r signal.					2			
	Radio wave propaga	ation, ra	idar equa	tion an	d maxin	num range.	3			
	Radar cross section).					3			
Course content	Estimation of target	positior	n parame	ters by	radar si	gnal.	2			
broken down in	Basic radar hardware.									
class schedule	Moving target indication (MTI) radar.									
(syllabus)	Doppler impulse rac	dar.					3			
	Synthetic aperture r	adar (S	AR).				2			
	Meteorological rada	ır.					2			
	Ultra wideband (UW	/B) rada	ar.				2			
	Target tracking.						2			
	Clutter cancelation i	in radar	systems.				1			
	List of laboratory exe	ercises					LE hours			
	Transmission and ref network analyzer.	lection I	measurer	nents c	of device	es using vector	2			
	Radar principles- the measurement of target distance.									
	Numerical simulation of target radar cross section.									
	The measurement of	bistatic	radar cro	oss sec	tion.		2			
	SAR radar concept- s	simulatio	on and m	easure	ments.		4			
	MTI radar concept- s	imulatio	n and me	easuren	nents.		2			
	UWB radar concept-	simulati	on and m	neasure	ements.		2			
	Group visit to HRM (0	Croatian	ı Navy) in	Lora.			5			
	Group visit to Naval o	centre o	f electron	ics (PC	E) Split		5			
	☑ lectures			⊠ inde	nender	nt assignments				
	\Box seminars and wor	kshops		\square multimedia						
Format of instruction				⊠ labo						
	□ <i>on line</i> in entirety			□ wor						
	☐ partial e-learning				(othe	er)				
0			1							
responsibilities	Performed all labora	tures in tory exe	the amou ercises re	unt of a quired.	t least /	0 % of the times sche	aulea.			
Screening student	Class attendance	1.5	Researc	h		Practical training				
proportion of ECTS	Experimental work		Report			Individual work				
credits for each activity so that the	Essay		Seminar essay		2	Laboratory exercises	1			
ECTS credits is equal to the ECTS	Tests	0,5	Oral exa	m		Preparation for laboratory exercises				
value of the course) Written exam Project (Other)			(Other)							
Grading and evaluating student work in class and at the final exam	There is one midterr lecturing and the sen The midterm test co includes individual w students that did not	ritten exam Project (Other) ere is one midterm test and seminar essay. The midterm test is after 7 weeks of sturing and the seminar essays are presented during the next part of the semester. e midterm test consists of theoretical questions and numerical. Seminar essay cludes individual work and work in groups, and the presentation of the results. The indepts that did not pass the test take part in the final exams and the presentation								

	 a the seminal essay is obligatory. The inditerm test is carried out as written test. a Grade(%) = 0,1 NP + 0,1 LV + 0,4 (M + S) a ectivities in percentage: NP - attendance at lectures, LV - laboratory assessment, M - test results, S- seminar essay 							
	Title	Number of copies in the library	Availability via other media					
Required literature (available in the	• M. Škiljo:: Radari, predavanja		e-learning portal					
media)	 Skolnik, M: Introduction to Radar Systems, McGraw-Hill, 1990. 	1						
	 Peebles, P. Z: "Radar Principles", John Wiley & Sons, 1998. 	1						
Optional literature (at the time of submission of study programme proposal)	 Tait, P: "Introduction to Radar Target Recognition Zentner, E.: Antene i radiosustavi, Graphis Zagrel 	", IEE, 2005. b, 2001.						
Quality assurance methods that ensure the acquisition of exit competences	 Evaluation of results in accordance with the above learning outcomes Feedback from students via surveys Self-evaluation of teachers Institutional and non-institutional evaluations 							
Other (as the proposer wishes to add)								

NAME OF THE COURSE	BIOELECTROMAGNETICS						
Code	FELJ24	Year of study	1.				
Course teacher	Antonio Šarolić, Ph.D., Full Professor	Credits (ECTS)	5	5			
Associate teachers	Niko Ištuk, Teaching Assistant	Type of instruction	L	S	AE	LE	DE
Status of the course	Elective	Percentage of	30 0			30	
	COURSE						
Course objectives Training students for: - understanding the human electrophysiology - acquiring knowledge on therapeutic and diagnostic methods - application of specialized interdisciplinary knowledge in biomedical a							ations
Course enrolment requirements and entry competences required for the course	lone.						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: describe the cell structure describe the electrophysiology of excitable cells and tissues apply the electrophysiology knowledge for understanding the brain and heart function analyze the electric activity of heart and brain with applications in diagnostics link the electrophysiology principles to the function of other bodily organs and to potential biomedical applications 						
	Course content				L hours	/ hc	\E ours
	Introduction and history.				2		0
	Structure of neuron and mu	uscle cells.			2		0
	Membrane potential.				2		0
	Axon as transmission line (cable).			2		0
O a series a series at	Membrane activation.				2		0
broken down in	Synapses, receptors and b	rain.			2		0
detail by weekly	Heart.				2		0
class schedule (syllabus)	Volume source. Volume co	nductor.			2		0
(Synabus)	Electrocardiography (ECG)).			2		0
	Electroencephalograhpy (E	EG).			2		0
	Electrophysiology of the eye. Electrodermal reaction. 2						
	Other diagnostic and therapeutic methods based on applied electromagnetics. Magnetic resonance imaging (MRI).						
	Visit to Medical School of the companies related to the companies relat	he University of Split. Visit	to		2		0
	List of laboratory or design	exercises				LE	nours
	Membrane potential.						4
	Axon as transmission line (cable).					2

	Membrane activation.						4
	Synapses, receptors	and bra	in.				2
	Electrocardiography	(ECG).					2
	Electroencephalogra	hpy (EE	G).				2
	Electrodermal reaction	on.					2
	Other diagnostic and electromagnetics. Ma	therape agnetic i	eutic metl esonanc	nods ba e imagi	ised on ng (MR	applied).	2
	Visit to Medical Scho related to the course	isit to Medical School of the University of Split. Visit to companies lated to the course topics.				6	
	⊠ lectures			□ inde	pondor	a assignments	
	\boxtimes seminars and wo	rkshops			timedia	it assignments	
Format of instruction	⊠ exercises			⊠ labo	oratory		
	□ on line in entirety				k with n	nentor	
	□ partial e-learning				(othe	er)	
	⊠ field work						
Student responsibilities	Student is required t least 70% of the sch the amount of 100% laboratory exercises	Student is required to attend the lectures and auditory exercises in the amount of at east 70% of the schedule. Student is required to attend the laboratory exercises in the amount of 100% of the schedule and to complete all tasks associated with aboratory exercises.					
Screening student	Class attendance	1	Researc	ch Practical training		Practical training	
proportion of ECTS	Experimental work	0,5	Report			Laboratory exercises	0,5
credits for each activity so that the total number of	Essay		Semina essay	-	1	Individual work	1
ECTS credits is	Mid-exam	0,5	Oral exa	am		(Other)	
value of the course)	Written exam	0,5	Project			(Other)	
Grading and evaluating student work in class and at the final exam	Written exam0,5Project(Other)During the semester, two mid-exams will be held. The first mid-exam will be held in the middles of the semester, while the second will be held after the lectures and exercises are completed, schedules to be agreed with the students.The first mid-exam is based on the first half of the course material. The second mid exam is based on the first second half of the course material.To pass at each mid-exam, min. 50% of points must be earned from the part of the exam containing numerical problems (material from auditory exercises) and min 50% of points must be earned from the part of the exam containing theory (materia from the lectures).To earn the right to approach the second mid-exam, min. 30% of points must be earned from the part of the first mid-exam containing numerical problems (material from auditory exercises) and min. 30% of points must be earned from the part of the first mid-exam containing theory (material from the lectures).If a student earns the positive grades on both mid-exams, he/she is considered to have passed the whole exam with the grade calculated as average from both mid exams.At the first exam term, students may choose to take the exam containing all the course material.Approaching the exams is subject to fulfilling the requirements on studen responsibilities.The overall point percentage defining the overall grade is calculated as the average for point percentage defining the overall grade is calculated as the average for point percentage defining the overall grade is calculated as the average					be held in stures and cond mid- part of the and min. y (material s must be s (material part of the sidered to both mid- g only that the course n student ie average ication:	

	50% - 62,4% -> sufficient (2)		
	62,5% - 74,9% -> good (3)		
	75% - 87,4% -> very good (4)		
	87,5% - 100% -> excellent (5)		
	Final grade can be supplemented by performing p	ractical projec	t work involving
	individual and experimental work, in agreement with t	the teacher.	
	Exam terms: according to the academic year calenda	ar	
	Title	Number of copies in the library	Availability via other media
Required literature (available in the library and via other media)	 Jaakko Malmivuo & Robert Plonsey: Bioelectromagnetism - Principles and Applications of Bioelectric and Biomagnetic Fields, Oxford University Press, New York, 1995. 		
	 Handbook of biological effects of electromagnetic fields (third edition): Bioengineering and Biophysical Aspects of Electromagnetic Fields, Ed. Frank S. Barnes and Ben Greenebaum, CRC Press, 2007. 		
	 Handbook of biological effects of electromagnetic fields (third edition): Biological and Medical Aspects of Electromagnetic Fields, Ed. Frank S. Barnes and Ben Greenebaum, CRC Press, 2007. 		
Optional literature (at the time of submission of study programme proposal)	 Šantić, A: Biomedicinska elektronika, Školska knji The Biomedical Engineering Handbook (Second I Bronzino, CRC Press, 2000. 	iga, Zagreb, 19 Edition), Ed. Jo	995. oseph D.
Quality assurance methods that ensure the acquisition of exit competences	Surveys providing student feedback		
Other (as the proposer wishes to add)			

NAME OF THE COURSE	ANTENNAS							
Code	FELJ33	Year of study	1.					
Course teacher	Antonio Šarolić, Ph.D., Full Professor	Credits (ECTS)	6					
Associate teachers	Niko Ištuk, Teaching Assistant	Type of instruction (number of hours)	L	S	AE	LE	DE	
Status of the course	Obligatory	Percentage of application of e-learning	0		15	15		
	COURSE	DESCRIPTION						
Course objectives Training students for: - understanding the phenomena of radiation - analysis of antennas as radiating structures - application of antennas in wireless communication systems								
Course enrolment requirements and entry competences required for the course	None.	one.						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: utilize the antenna parameters as the basis for antenna application in ICT elaborately assess the applicability of a certain antenna for specific purpose calculate the electromagnetic field in the surrounding of simple antenna structures analyze the parameters of linear antennas analyze simple uniform antenna arrows 							
	Course content			L	or S	/ hc	\E ours	
	Introduction. Antenna para pattern.	meters. Polarization. Radi	ation		2		1	
	Directivity. Gain. Antenna i	mpedance. Effective area.	i i		2		1	
	Effective length. Antenna factor. Relations linking the antenna 2							
	Elementary electrical dipole	e (EED). Field around the	EED.		2		1	
Course content	Radiated power and radiati EED.	ion resistance of EED. Effi	ciency	of	2		1	
broken down in	Zones surrounding the ante	enna – near and far field.			2		1	
class schedule	Resonant dipoles. Halfwav	e dipoles. Fullwave dipole	S.		2		1	
(syllabus)	Electrically short dipole and	d unipole.			2		1	
	Mutual impedance of dipole	es.			2		1	
	Antenna array. Uniform linear antenna array. 2						1	
	Array with uniform amplitude distribution. 2 1						1	
	Arrays with non-uniform an	nplitude distribution.			2		1	
	Practical examples of anter	nna installations in use – f	ield trip.		2		1	
	List of laboratory or design	exercises				LE	nours	
	Introduction. Antenna parar Directivity. Gain. Antenna ir	neters. Polarization. Radia npedance. Effective area.	ation pa	ttern.			2	

	Effective length. Antenna factor. Relations linking the antenna parameters. Friis equation. Elementary electrical dipole (EED). Field around the EED.					e antenna ole (EED). Field	2
	Radiated power and Zones surrounding th	radiation ne anten	n resistar ina – nea	nce of E ir and fa	ED. Eff ar field.	iciency of EED.	2
	Resonant dipoles. Ha	alfwave	dipoles. I	Fullwav	e dipole	es. Electrically short	2
	Mutual impedance of array.	f dipoles	. Antenna	a array.	Uniforn	n linear antenna	2
	Array with uniform ar amplitude distributior	nplitude า.	distribut	on. Arra	ays with	non-uniform	2
	Practical examples o	ractical examples of antenna installations					1
Format of instruction	 ☑ lectures ☑ seminars and wo ☑ exercises ☑ on line in entirety ☑ partial e-learning ☑ field work 	 □ seminars and workshops □ exercises □ on line in entirety □ partial e-learning ☑ field work □ Student is required to attend the lectures and auditory exercises in the amount of the lectures and auditory exercises in the lectures and auditory exercises in the amount of the lectures and auditory exercises in the amount of the lectures and auditory exercises in the amount of the lectures and auditory exercises in the amount of the lectures and auditory exercises in the amount of t					
Studentresponsibiliti es	Student is required to attend the lectures and auditory exercises in the amount of at least 70% of the schedule. Student is required to attend the laboratory exercises in the amount of 100% of the schedule and to complete all tasks associated with laboratory exercises.						
Screening student	Class attendance	2	Researc	h		Practical training	0,5
proportion of ECTS	Experimental work	0,5	Report			Laboratory exercises	0,5
eachactivity so that the total number of	Essay		Seminal essay	r		Individual work	1
ECTS credits is	Mid-exam	0,5	Oral exa	am		(Other)	
value of the course)	Written exam	0,5	Project		0,5	(Other)	
Grading and evaluating student work in class and at the final exam	Written examU,SProjectU,S(Other)During the semester, two mid-exams will be held. The first mid-exam will be held in the middles of the semester, while the second will be held after the lectures and exercises are completed, schedules to be agreed with the students.The first mid-exam is based on the first half of the course material.To pass at each mid-exam, min. 50% of points must be earned from the part of the exam containing numerical problems (material from auditory exercises) and min. 50% of points must be earned from the part of the exam containing theory (material from the lectures).To earn the right to approach the second mid-exam, min. 30% of points must be earned from the part of the first mid-exam containing numerical problems (material from auditory exercises) and min. 30% of points must be earned from the part of the first mid-exam containing theory (material from auditory exercises) and min. 30% of points must be earned from the part of the first mid-exam containing theory (material from the lectures).If a student earns the positive grades on both mid-exams, he/she is considered to have passed the whole exam with the grade calculated as average from both mid- exams.At the first exam term, students may choose to take the exam containing only that half of the material that they haven't passed at mid-exams.At all other exam terms, students must take the whole exam, containing all the course						

	Approaching the exams is subject to fulfilling to responsibilities. The overall point percentage defining the overall grad of points earned in all exam questions, corrected by to Percentage -> Grade 50% - 62,4% -> sufficient (2) 62,5% - 74,9% -> good (3) 75% - 87,4% -> very good (4) 87,5% - 100% -> excellent (5) Final grade can be supplemented by performing point individual and experimental work, in agreement with the Exam terms: according to the academic year calendary	the requirement de is calculate the result of or ractical project the teacher.	ents on student d as the average al verification: ct work involving					
Required literature	TitleNumber of copies in the libraryAvailabili other me							
(available in the library and via other media)	 E. Zentner: Antene i radiosustavi, Graphis, Zagreb 2001. 							
moday	 Constantine A. Balanis: AntennaTheory: Analysisand Design, Wiley, 1997. 							
Optional literature (at the time of submission of study programme proposal)	 V. Roje: Antene I dio, skripta, Sveučilište u Splitu 1981. Handbook of antennas in wireless communications, CRC Press, 2002. 							
Quality assurance methods that ensure the acquisition of exit competences	Surveys providing student feedback							
Other (as the proposer wishes to add)								

NAME OF THE COURSE	ELECTROMAGNETIC COMPATIBILITY						
Code	FELH25	Year of study	2.				
Course teacher	Dragan Poljak, Ph.D., Full Professor Antonio Šarolić, Ph.D., Full Professor	Credits (ECTS)	6				
Associate teachers	Niko Ištuk, Teaching Assistant	Type of instruction (number of hours)	L S 45	AE	LE DE		
Status of the course	Obligatory	Percentage of 0 application of e-learning					
	COURSE	DESCRIPTION					
Course objectives	 Training students for: understanding the election systems application of acquired circuits, devices and sy application of acquired systems to electromag 	tromagnetic phenomena i knowledge to prevent ele- /stems knowledge to improve imp netic disturbances	n circuits, d ctromagnet munity of ci	evices ar ic interfer rcuits, de	nd rence from vices and		
Course enrolment requirements and entry competences required for the course	None.						
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: analyze electronic components and circuits from the aspect of electromagnetic compatibility calculate electromagnetic field around parasitic antenna structures, as well as disturbance voltages induced in such structures analyze the conducted emissions and susceptibility of electrical devices design filters for rejection of disturbances analyze shielding and grounding of electrical devices and circuits test the electromagnetic compatibility by measurements in accordance with standards and regulations analyze electromagnetic compatibility of devices and systems using models with concentrated parameters, distributed parameters and transmission lines 						
	Course content			L	AE		
	Introduction to electromage	petic compatibility		nours 2	nours 1		
	Electronic components and	their equivalent circuits		3	1		
	Radiated emissions and su	sceptibility.		3	1		
Course content broken down in	Conducted emissions and	susceptibility		3	1		
detail by weekly	Filtering.		3	1			
class schedule	Shielding.			3	1		
(Syllabus)	Grounding.			3	1		
	Measurements in electrom	agnetic compatibility.		3	1		
	Electromagnetic compatibil regu- lations. Electromagne radiocommunication system	ity requirements, standarc etic compatibility in ns.	ls and	3	1		

	Historical overview of with concentrated path	storical overview of EMC modelling. Low-frequency models 3 h concentrated parameters.					3	1
	High-frequency mod	lels with	distribute	ed para	meters.		3	1
	Analysis of wire ante	ennas in	EMC ap	plicatio	ns.		3	1
	Transmission line m	odels.					3	1
	List of laboratory or	design e	exercises					LE hours
	Introduction to electro	omagne	tic compa	atibility.				1
	Electronic componer	nts and t	heir equiv	/alent c	ircuits.			1
	Radiated emissions	and sus	ceptibility					1
	Conducted emission	s and su	usceptibili	ty				1
	Filtering.	tering.					1	
	Shielding.							1
	Grounding.	rounding.						1
	Measurements in ele	leasurements in electromagnetic compatibility.					1	
	Electromagnetic corr Electromagnetic corr	patibility	y requirer y in radio	nents, : commu	standaro nication	ds and regula systems.	ations.	1
	Historical overview of EMC modelling. Low-frequency models with concentrated parameters.					h	1	
	High-frequency mod	els with	distribute	d parar	neters.			1
	Analysis of wire antennas in EMC applications.						1	
	Transmission line models.					1		
Format of instruction	 ☑ lectures ☑ seminars and workshops ☑ exercises ☑ on line in entirety ☑ partial e-learning ☑ (ot 			epender Itimedia oratory k with n (othe	nt assignmen nentor vr)	ts		
Studentresponsibiliti es	Student is required t least 70% of the sch the amount of 100% laboratory exercises	o attend edule. S of the s	the lectu Student is schedule	res and require and to o	d audito ed to att complet	ry exercises end the labo e all tasks as	in the arr ratory ex sociated	ount of at ercises in with
Screening student	Class attendance	2	Researc	h		Practical tra	ining	0,5
work (name the proportion of ECTS	Experimental work	0,5	Report			Laboratory e	exercises	0,5
credits for eachactivity so that the total number of	Essay		Seminai essay			Individual w	ork	1
ECTS credits is	Mid-exam	0,5	Oral exa	ım		(Othe	er)	
equal to the ECTS value of the course)	Written exam	0,5	Project		0,5	(Othe	er)	
Grading and evaluating student work in class and at the final exam	During the semester the middles of the s exercises are compl The first mid-exam is exam is based on th To pass at each mid exam containing nu 50% of points must from the lectures).	r, two m semeste eted, sc s based e first se d-exam, imerical be earne	id-exams r, while the hedules to on the fir econd ha min. 50% problem ed from the	will be he sec o be ag st half f of the o of poi s (mate ne part	held. T ond will greed w of the co course nts mus erial from of the e	he first mid-e be held afte th the studer ourse materia material. the earned mauditory e xam contain	exam will er the lec nts. al. The se from the xercises) ing theory	be held in ctures and cond mid- part of the and min. y (material

	To earn the right to approach the second mid-exam, min. 30% of points must be earned from the part of the first mid-exam containing numerical problems (material from auditory exercises) and min. 30% of points must be earned from the part of the irst mid-exam containing theory (material from the lectures). If a student earns the positive grades on both mid-exams, he/she is considered to have passed the whole exam with the grade calculated as average from both mid- exams.							
	At the first exam term, students may choose to take half of the material that they haven't passed at mid-e. At all other exam terms, students must take the whole material.	At the first exam term, students may choose to take the exam containing only that half of the material that they haven't passed at mid-exams. At all other exam terms, students must take the whole exam, containing all the course material.						
	Approaching the exams is subject to fulfilling the requirements on student responsibilities. The overall point percentage defining the overall grade is calculated as the average of points earned in all exam questions, corrected by the result of oral verification: Percentage -> Grade 50% - 62,4% -> sufficient (2) 62,5% - 74,9% -> good (3) 75% - 87,4% -> very good (4) 87,5% - 100% -> excellent (5) Final grade can be supplemented by performing practical project work involving individual and experimental work, in agreement with the teacher. Exam terms: according to the academic year calendar							
Required literature	Title	Number of copies in the library	Availability via other media					
(available in the library and via other	 Clayton R. Paul: Introduction to ElectromagneticCompatibility, Wiley, 2006. 							
media)	 Dragan Poljak: "Advanced modelingincomputationalelectromagneticcompat ibility", WileyInterscience, 2007. 							
Optional literature (at the time of submission of study programme proposal)	 HandbookofElectromagneticCompatibility, ed. R. Tesche, F.M.: lanoz, M.V., Karslsson, T.: EMC AnalysisMethodsandComputationalModels, John 	Perez, Acader Wiley&Sons, [,]	nic Press, 1995. 1997.					
Quality assurance methods that ensure the acquisition of exit competences	Surveys providing student feedback							
Other (as the								

NAME OF THE COURSE	ELECTROMAGNETIC ECOLOGY AND DOSIMETRY							
Code	FELJ26	Year of study	2					
Course teacher	Dragan Poljak, Ph.D., FullProfessor	Credits (ECTS)	4	4				
Associate teachers	Anna Šušnjara, TeachingAssistant	Type of instruction (number of hours)	S 0	AE 0	LE 15	DE		
Status of the course	Obligatory	Percentage of application of e-learning	0					
	COURSE	E DESCRIPTION						
Course objectives	 Training students for: Understandingandapp simetry, Assessmentof lowfrequencyandhight Permanentadoptingar Applicationofnationala exposure to non-ionis 	blyfundamentalprinciplesof human frequencyelectromagnetic nddeepeningknowledgeintl andinternationalregulations ingradiation	electror exp Tields neareac for th	magne posure ofbioel easse	eticanc e lectron essme	ltherm nagne ntof h	to to tism uman	
Course enrolment requirements and entry competences required for the course	- Electromagnetic fields, Electromagnetic waves							
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - Definefundamentalnotionsinbioelectromagnetics, - Applymethods for themeasurementofexternal LF and HF fields - Applymethods for thecalculationofexternal LF and HF fields - Analyzethelevelofthe human bodyexposure to non- ionizingradiationusingnationalandinternationalregulations - Mathematicallyformulatesimplecasesofelectromagneticwaveandradiationfromthi nwirestructures. - Analyzesimpletransmissionlines, groundingsystemsandantennas - Computefundamentalparametersofinternaldosimetrybymeansofsimplebodymod els. - Use commercial software packages for							
	Course content				L hours	/ hc	\E burs	
	Electrosmog: electromagneticpollutionoftheenvironment. 2							
Course content broken down in detail by weekly Couplingmechanismsofelectromagneticfieldandthe human body. Biologicaleffectsofelectromagneticfields. Lowfrequencyandhighfrequencyeffects. Epidemiologicalandstatisticalstudies.					2			
(syllabus)	Fundamentalquantitiesofel currentdensity, inducedel (SAR), specificabsorption(ectromagneticdosimetry, ectricfield, specificabsorp SA), externalfields, powerc	otion ra density.	ate	2			
	Guidelines for protection and international regulations leves. Protection measures	nofnon-ionisingradiation. Basicrestrictionsand	Nation refere	nal ent	2			

	Methodsoftheoretica and internal field dosin	landexp netry.	erimenta	ldosime	etry.	Incider	^t 2		
	Incident fielddosir Calculationandmeas powerlinesandsubsta	metry; uremen ationtrar	Radiati tof LF ensformers	onsourc electricfi 3.	cechara ield. E>	cterizatior cposure t	D 2		
	Incident fielddosim electromagneticfield mobilephones, base	etry; C . Exp stations	Calculatio Dosure S.	nandme to F	easurem RFID	nentof H antennas	= , 2		
	Classificationofmode Simplifiedandanatom	els nicalbod	for ymodels		interna	ldosimetry	^{7.} 2		
	LF El Electromagneticmod lowfrequencies.	ectroma lelingoft	agneticmo hebody.	odeling. Whole	bodyex	L posure t	= p 2		
	HF Electromagnetion	cmodeli 1.	ng. The	eyeand	brainex	posure t	2		
	The human bodyexp	osure to	o transier	tradiati	on.		2		
	Thermalresponseof the human body exposed to HF electromagnetic radiation visokih frekvencija. Thermalresponse to the eyeand braindue to plane wave exposure.						= 2 e		
	Biomedicalapplicationsofelectromagneticfields. Electricalstimulationofnerves. Laser radiationoftheeye. Methodsofthe human brainstimulation. Transcranialmagneticstimulation.					2			
	List oflaboratoryor design exercises							LEr	nours
	Human exposure to non-ionising EM radiation (frequenciesup to 10 N					to 10 MHz)		2	
	Human exposure to non-ionising EM radiation (frequenciesabove 10 MH:					ve 10 MHz)		2	
	Measureequipmentai EM fields	ndmetho	ods for th	easses	smento	f human e	exposure to		3
	Measurementof LF e	lectricfie	elds						2
	Measurementof LF m	nagnetic	fields						2
	Measurementof HF E	M fields	3						2
	EM fieldcalculationint	thevicini	tyof base	station	IS				2
Format of instruction	 ➢ lectures ☐ seminars and workshops ☐ exercises ☐ on linein entirety ☐ partial e-learning ☐ field work 								
Studentresponsibiliti es	The presence on lec Performed all require	tures in ed labor	the amo atory exe	unt of a	t least 7	0 % of the	times sche	edule	ed.
Screening student	Class attendance	1,8	Researc	h		Practical	training		
work (name the proportion of ECTS	Experimental work		Report			(C	ther)		1,8
credits for eachactivity so that the total number of	Essay		Seminai essay			(C	ther)		0,1
ECTS credits is	Tests	0,1	Oral exa	ım		(C	ther)	T	0,1
equal to the ECIS value of the course)	Written exam	0,1	Project			(Ot	her)		

	There are two midterms and final exams. The first mi lecturing and the second one is after the next 6 week in duration) consists of 3 questions (each contain numerical problem) and 2 longer numerical problems grade is the positive assessment of laboratory exerc midterm. Grade (in percentage) is formed according to	dterm exam is ks. Each midte ing theoretica s. The require cises and 50 % to the formula:	after 7 weeks of erm test (120 min I part and short ment for passing 6 points on each				
	Grade(%) = 0,5 (M1 + M	2)					
Grading and	where M1 and M2 are the midterm test results, and is percentage score:	s determined tl	hrough following				
evaluating student work in class and at	Percentage score: Grade:						
	From 50% to 62% sufficient (2) From 63% to 75% good (3) From 76% to 88% very good (4) From 89% to 100% excellent (5)	From 50% to 62% sufficient (2) From 63% to 75% good (3) From 76% to 88% very good (4) From 89% to 100% excellent (5)					
	Students who do not pass midterm exams are obliged to pass final test (150 min in duration) in winter/fall examination period. Final test consists of 4questions(each containing theoretical part and short numerical problem) and 2 longer numerical problems. The requirement for passing grade is 50 % points.Final grade isformedaccording to thedescribed procedure.The midterm and final exams are carried out as written tests.						
Required literature	Title	Number of copies in the library	Availability via other media				
(available in the library and via other media)	D.Poljak, Teorija elektromagnetskih polja s primjenama u inženjerstvu, Šk. knjiga Zagreb, 2014.						
	D. Poljak: <i>Izloženost ljudi elektromagnetskom zračenju</i> , Kigen, Zagreb, 2007.						
Optional literature (at the time of submission of study programme proposal)	 D. Poljak, AdvancedModelinginComputationalElectromagneticcompatibility, WileyInterscience, New York 2007. D. Poljak: Human Exposure to Electromagnetic Fields, WIT Press, Southampton- Boston, 2003 R.W.Y. Habash, ElectromagneticFieldsandRadiation, Marcel Dekker, 2002. D. Poljak: Exposure of Humans to Electromagnetic Radiation, SoftCOM Library 2002 						
Quality assurance methods that ensure the acquisition of exit competences	 Evaluation of results in accordance with the above learning outcomes Feedback from students via surveys Self-evaluation of teachers Institutional and non-institutional evaluations 						
Other (as the							

NAME OF THE COURSE	MEASUREMENTS IN WIRELESS SYSTEMS								
Code	FELJ22	Year of study	2						
Course teacher	Zoran Blažević, Ph.D., Full Professor	Credits (ECTS)	5						
Associate teachers	Maja Škiljo, Ph.D.	Type of instruction (number of hours)	L 30	S 0	AE 15	LE 15	DE 0		
Status of the course	Obligatory: 241 Elective: 242	Dbligatory: 241 Percentage of application of e-learning 0							
	COURSE DESCRIPTION								
Course objectives	 Training students for: radio-channel measure statistical modelling of various radio systems, applying empirical and 	 Training students for: radio-channel measurements and analysis, statistical modelling of radio propagation in different environments and for various radio systems, applying empirical and statistical models for radio-channel characterization. 							
Course enrolment requirements and entry competences required for the course	Finished the undergraduate study of Communications and Information Technology								
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: calculate radio-channel parameters, perform measurements and analysis of fixed and mobile radio systems parameters statistically characterize radio propagation of arbitrary radio-systems on the base of measurements, Apply various channel models 								
	Course content				L nours	A ho	\E ours		
	Introduction to Measurements in Wireless Systems.						1		
	Fixed radio-links channel p	arameters. Fading			2		1		
	Ground radio links planning and measurements						2		
	Fading in mobile radio channels.						1		
	Mobile radio channel parar	neters.			2		1		
	Propagation path-loss mod	lels. Hata-Okumura model			3		1		
Course content	First midterm exam								
broken down in detail by weekly	Statistical channel models with Maxwell theory based	of ground networks compa model.	arison		2		1		
class schedule (syllabus)	Satellite radio-channels. St measurements (Loo model	atistical models based on , Suzuki model).			4		1		
	Wide-band channel param	eters. Wide-band measure	ements.		4		3		
	Wide-band channel models	s based on measurements	i.		2		1		
	Wide-band indoor radio channel modelling.						1		
	Second midterm exam								
	List of laboratory exercises					LE	nours		
	Antenna measurements by Vector Network Analyser measurements. Measurements calibration.				ts.		3		
Narrow-band channel measurements at various frequencies.							3		

	Wide-band channel r	neasure	ements					3
	Wide-band indoor ch	annel m	easurem	ents				3
	Radio-links planning	by using	g measur	ed data a	ind sof	tware.		3
Format of instruction	 ☑ lectures ☑ seminars and workshops ☑ exercises ☑ on line in entirety ☑ partial e-learning ☑ field work 			 □ independent assignments □ multimedia ☑ laboratory □ work with mentor □ (other) 				
Studentresponsibiliti es	The presence on lec Performed all labora	tures in tory exe	the amo ercises re	unt of at le quired.	east 70	0 % of the time	es sched	uled.
Screening student	Class attendance	2,0	Researc	h		Practical traini	ng	
work (name the proportion of ECTS credits for eachactivity so that the total number of ECTS credits is equal to the ECTS	Experimental work		Report			Individual work	κ	1.5
	Essay		Seminai essay			Laboratory exe	ercises	0,8
	Tests	0,5	Oral exa	ım		Preparation fo 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	 Inere are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm test and final tests consists of theoretical questions and numerical. The students that did not pas the midterm exams take part In the final exams. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises and 40 % points on each midterm exam or th final exam. Grade (in percentage) is formed according to the formula: Grade(%) = 0,1 NP + 0,1 LV + 0,4 (M1 + M2) the activities in percentage: NP - attendance at lectures, LV – laboratory assessment, M1, M2 – test results. 						and final not pass ams are positive m or the	
	Title				Number of copies in the library	Availat other	oility via media	
Required literature (available in the	 Z. Blažević; Mjer predavanja 	enja u b	ežičnim s	sustavima	a,		e-lea po	arning rtal
library and via other media)	 M. Patzold: "Mob 2002. 	oile Fadi	ngChann	els", Wile	ey,	1		
	Doble, J.: "Introduction to Radio Propagation for Fixedand Mobile Communications", Artech House Boston - London, GB, 1996.				1			
Optional literature (at the time of submission of study programme proposal)	G. H. Bryant: "PrZentner, E.: Ante	inciples ene i rad	of Microv iosustavi	wave Mea , Graphis	asuren Zagre	nents", IEE Pu b, 2001.	blishing,	1993.
Quality assurance methods that ensure	 Evaluation of res Feedback from s Self-evaluation c 	sults in a students of teach	accordan s via surve ers	ce with th eys	e abov	ve learning out	comes	

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

NAME OF THE COURSE	SYSTEMS FOR WIRELES	SS TRANSMISSION OF E	NERG	Y				
Code	FELJ36	Year of study	2					
Course teacher	Zoran Blažević, Ph.D., Full Professor	Credits (ECTS)	5					
Associate teachers	Maja Škiljo, Ph.D.	Type of instruction (number of hours)	L 30	S 0	AE 0	LE 30	DE 0	
Status of the course	Elective	Percentage of application of e-learning	0					
	COURSE	DESCRIPTION	8					
Course objectives	 Training students for: understanding of basic transmission of energy designing of radio system calculation and analysi 	 raining students for: understanding of basic principles of and problemacy of systems for wireless transmission of energy, designing of radio system for near-field transmission of energy design of radio system for far-field power transmission calculation and analysis of wireless energy systems parameters 						
Course enrolment requirements and entry competences required for the course	Finished the undergraduate study of Communications and Information Technology.							
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - analyse power and ene - calculate and estimate - designing basic transm	ergy transmission techniqu wireless energy transmiss ission system schemes fo	ies, sion sys or given	tem p servic	arame :e	ters,		
	Course content			H	L nours	ہ hc	∖E ours	
Course content	Introduction. Historical pers transmission.	spective of radio and wirele	ess		2			
broken down in detail by weekly class schedule	Principles and techniques f Transformers and resonan electrically small antennas.	or radio-transmission of e t transformers (Tesla Coil)	nergy. , and		4			
(syllabus)	Antenna scattering matrix. Spherical Mode Theory-An transmission of energy sys	Coupled-Mode Theory an tenna Model application to tems.	d o wirele:	SS	4			
	Rectennas.				2			

	Near-field energy and power transmission. Resonant transformer.					4	
	Far-field power trans	sfer.				4	
	Ground energy trans	sfer by fa	ar-field sy	stems	concept	3	
	Satellite energy trans	sfer sys	tem conc	ept		3	
	Norms and standard standard	ls for wii	reless en	ergy tra	nsfer. Qi	2	
	Electromagnetic Comp	atibility o	of wireless	energy	transfer systems.	2	
	Interference problem and radio systems for	n betwee or wirele	en radio-o ss energ	commui y transf	nications systems er.	2	
	Midterm exam						
	List of laboratory exe	ercises					LE hours
	Measurements and adjustments of inductively fed electrically sn antennas					nall	8
	Measurements of tra Oscilloscope	nsfer pe	erformanc	es by S	Spectrum Analyser,	and by	8
	Measurements of transfer performances by Vector Network A					alyser	6
	Tesla Coil Measurem	nents.					8
Format of instruction	 ☑ lectures ☑ seminars and workshops ☑ exercises ☑ on line in entirety ☑ partial e-learning 			 independent assignments multimedia laboratory work with mentor (other) 			
On the state of the little			11			C	
Studentresponsibiliti es	Performed all labora	tory exe	the amore	unt of a quired.	t least 70 % of the	times sche	duled.
Screening student	Class attendance	1.5	Researc	h	Practical tr	Practical training	
work (name the proportion of ECTS	Experimental work		Report		Individual	work	2
credits for eachactivity so that	Essay		Seminar essay	•	Laboratory	exercises	0,8
ECTS credits is equal to the ECTS	Tests	0,5	Oral exa	ım	Preparatio laboratory	n for exercises	0,2
value of the course)	Written exam		Project		(Oth	ner)	
Grading and evaluating student work in class and at the final exam	written exam Project (Other) There are one midterm and one final exam. Both midterm test and final test cons of theoretical questions and numerical problems. The students that did not pass the midterm exams take part In the final exams. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment laboratory exercises, 40 % points on the midterm exam or the final exam, and the rest of the grade depends on the seminary work presented by the student. Grade of percentage) is formed according to the formula: Grade(%) = 0,1 NP + 0,1 LV + 0,4 (M + S) the activities in percentage: NP - attendance at lectures, LV - laboratory assessment, M - test results.,						est consist are carried essment of n, and the Grade (in

	Title	Number of copies in the library	Availability via other media			
Required literature	 Ki Young Kim (editor), "Wireless Power Transfer-PrinciplesandEngineeringExplorations", InTech, January 2012. 		e-learning portal			
library and via other media)	 Volakis J., C. C. Chen and K. Fujimoto, "Smallantennas: miniaturizationtechniquesandapplications", New York, McGraw-Hill, 2010. 		e-learning portal			
	 Special issue "Solar Power Satellite and Wireless Power Transmission", IEEE Microwave Magazine, Vol. 3, No. 4, December 2002. 	1				
Optional literature (at the time of submission of study programme proposal)	 Lee J. and S. Nam, "Fundamental aspects of near-field coupling small antenna for wireless power transfer", IEEE Trans. Antennas Propag., Vol. 58, No. 12, 3442-3449, 2010. P. Sample, D. T. Meyer, J. R. Smith: Analysis, experimental results, and range adaptation of magnetically coupled resonators for wireless power transfer, IEE Transactions on Industrial Electronics, Vol. 58, No. 2, 2010, p.p 544-554. N. Tesla, A. Marinčić: Colorado Springs Notes, Nolit, Beograd, 1978. Carol Gray Montgomery, Robert Henry Dickeand Edward M. Purcell, "Drinsiplecefmicrowavariavita", McCraw Hill Book Company, Iso, 1954, 1048. 					
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 	Evaluation of results in accordance with the above learning outcomes Feedback from students via surveys Self-evaluation of teachers				
Other (as the proposer wishes to add)						

NAME OF THE COURSE	MEDICAL DEVICES							
Code	FELH18	Year of study	2.					
Course teacher	Antonio Šarolić, Ph.D., Full Professor Ivan Marinović, Ph.D., Full Professor	Credits (ECTS)	5					
Associate teachers	Niko Ištuk, mag. ing. el.	Type of instruction (number of hours)	L S 30	AE	LE DE 30			
Status of the course	Elective	Percentage of application of e-learning	0					
	COURSE	DESCRIPTION						
Course objectives	 learning the types, reali electronic/communication knowledge on therapeu understanding the spect electronic devices understanding and application and development 	electronic/communication/information technology in medical domain knowledge on therapeutic, diagnostic and control medical electronic devices understanding the specifics of functional and safety requirements for medical electronic devices understanding and application of success criteria for medical device innovation and development						
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: employ their knowledge on electronic/communication/information technology for analysis and development of medical devices use the knowledge of human physiology, especially electrophysiology, for analysis and development of medical devices analyze the components of medical electronic devices and their interaction with human body medical electronic devices conceive the electronic circuits for application in a medical device characterize a medical electronic device from the aspect of safety 							
	Course content			L hours	AE hours			
	Basics of human electrophy	ysiology and electrophysic	ology	2	0			
	Measurement medical elec	tronic devices		2	0			
	Diagnostic medical electror	nic devices		2	0			
	Therapeutic medical electro	onic devices		2	0			
	Electronic circuits and com	ponents in medical device	S	6	0			
Course content broken down in	Circuits and devices for ele frequencies	ectric and magnetic stimula	ation at low	2	0			
detail by weekly	Circuits and devices for the	ermal procedures at high fr	requencies	2	0			
class schedule (syllabus)	Electrical safety aspects ar aspects of medical electror	nd electromagnetic companic devices	tibility	2	0			
	Control and auxiliary medic Theranostic medical electro therapeutics and diagnostic methods	cal electronic devices. E-H onic devices – unifying the cs in innovative medical de	ealth. evices and	2	0			
	Translational resaerch and from lab to clinics (from the Assessment of clinical and technology (Health Techno	development of medical development of medical de workbench to the bedside economic efficacy of med logy Assessment - HTA)	levices e). ical	2	0			

	Clinical studies: prin of medical devices	ciples a	nd impler	nentatio	on of clii	nical trials	2		0
	List of laboratory or	design e	exercises					L	E hours
	Basics of human elec	ctrophys	iology						2
	Amplifier circuits								4
	Electrostimulator circ	uits							4
	Noise and disturband	e suppr	ession in	electro	nic dev	ices			2
	Electromagnetic com	patibility	/ testing						2
	Electrical safety testi	ng							2
	Measurements of die	elctric pr	operties o	of tissue	es				2
	Measurement, diagn field trip (visit to med	leasurement, diagnostic and therapeutic medical electronic devices – eld trip (visit to medical establishments)							8
	☑ lectures			🗆 inde	nender	nt assignmen	ite		
	\boxtimes seminars and wo	rkshops			timodia	it assignmen	113		
Format of instruction	⊠ exercises								
Format of instruction	□ on line in entirety	□ on line in entirety				ontor			
	□ partial e-learning								
	⊠ field work				(otne	r)			
Studentresponsibiliti es	Student is required t least 70% of the sch	o attenc edule.	the lectu	ires and	d audito	ry exercises	in the a	amoi	unt of at
Screening student work (name the	Class attendance	1	Researc	h		Practical tra	ining		
proportion of ECTS credits for	Experimental work	0,5	Report			Laboratory exercises		es	0,5
eachactivity so that	Essay		Seminar essay		1	Individual work			1
ECTS credits is	Mid-exam	0,5	Oral exa	Im		(Other)			
equal to the ECTS value of the course)	Written exam	0,5	Project			(Other)			
Grading and evaluating student	Lectures are given in	n collabo	oration of	prof. Š	arolić (2	2/3 of lecture	hours)	and	prof.
work in class and at	Evam: presentation	ture not and def	Irs). anse of th	na sami	nar acc	21/			
the final exam	Exam: presentation			ic serii		Number			
	Title				copies in the librar	7 Ava 1 01 V	ailab her	oility via media	
Required literature (available in the	Ante Šantić: Biomec knjiga, Zagreb, 1995	licinska 5.	elektronil	ka, Ško	lska				
media)	Jaakko Malmivuo &	Robert I	Plonsey:						
	Bioelectromagnetism	n - Princ	iples and	Applic	ations				
	of Bioelectric and Bi	omagne	tic Fields	, Oxfor	d				
	- Handbook of bio	logical e	ffects of	electror	nagneti	r fields (third	edition	<i>.</i>).	
Optional literature	Bioengineering ar	nd Bioph	ysical As	pects of	Electron	magnetic Fiel	ds, Ed.	Fran	nk S.
(at the time of	Barnes and Ben (Greeneb	aum, CRO	Press	, 2007.		·.· 、 -		
submission of study	 Handbook of biolo Medical Aspects (ogical eff	ects of el	ectroma Fields	Ignetic fi Ed Era	elds (third ed	ition): E and Be	31010(Sin	gical and
programme	Greenebaum, CR	C Press	, 2007.	, 1 10103,	Lu. 11a	ink 0. Dames			
proposal)	- The Biomedical E	ngineeri	ng Handb	ook (Se	econd Ec	dition), Ed. Jo	seph D	. Bro	onzino,
	CRC Press, 2000								
methods that ensure the acquisition of exit competences	Surveys providing st	udent fe	edback						
Other (as the proposer wishes to add)									

NAME OF THE COURSE	RADIO COMMUNICATIONS								
Code	FELJ02	Year of study	1.						
Course teacher	Zoran Blažević, Ph.D., Full Professor	Credits (ECTS)	5						
Associate teachers	Maia Škilio, Ph D	Type of instruction	L	S	AE	LE	DE		
		(number of hours)	30	0	15	15	0		
Status of the course	Obligatory	Obligatory Percentage of application of e-learning 0							
COURSE DESCRIPTION									
Course objectives	 Training students for: understanding and application of basic principles and mechanisms of Earth radio-propagation, radio-channel physical phenomena modelling, permanent adoption and deepening of knowledge in the field of radio engineering 								
Course enrolment requirements and entry competences required for the course	Finished the undergraduate study of Communications and Information Technology								
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: define the fundamental phenomena, the quantities and the laws of Earth radio-propagation, apply fundamental laws of radio-propagation and model basic radio-channels, calculate and estimate basic radio-channel parameters, apply channel models for radio-signal quality estimation apply basic methods of radio-channel measurements 								
	Course content				L	<i>, ,</i>	4E		
	Introduction to Radio Com	nunications. History persp	ective c	of	nours 1	hc	-		
	Radiowave propagation. S Atmosphere.	urface Waves. Division of			2		1		
	Radio-antenna parameters a	and effective isotropic radiat	ed powe	ər.	2		2		
	Free space radiowave prop	bagation. Radio-gain.			2		1		
Course content	Propagation by Troposphe	re			1		1		
broken down in	Effective Earth Radius Mod	del and Flat Earth Model.	Ducting.		3		1		
detail by weekly	Radio-horizon by refraction	. Influence of Earth curvat	ure		2		1		
(syllabus)	Tropospheric loss by hydro	meteors and gasses			1		1		
	Propagation by lonosphere)			3		1		
	First midterm exam								
	Propagation by diffraction. Knife-Edge Model.	Fresnel wave theory on di	ffractior	۱.	4		1		
	Approximate methods for n	nultiple diffraction loss esti	mation		2		2		
	Geometrical Theory of Diff	eometrical Theory of Diffraction. Keller's law of diffraction.			1		1		
	Propagation by reflection. I Ground roughness influence	Fresnel reflection coefficience. Divergence factor.	nts.		4		1		

	Interference by direc	t and g	round refl	ected w	vave. Po	wer law.	2		1
	Second midterm exa	am							
	List of laboratory exe	ercises						L	E hours
	Introduction to labora	tory ins	truments	, device	es and of	ther equipm	nent		2
	Reflection parameter	s meas	urements	;					4
	Transmission parame	eters me	easureme	ents					4
	Measurements of rac	lio-chan	inels by s	pectrun	n analys	er			3
	Software estimations	of diffra	action los	S					2
	☑ lectures			□ inde	nondon	t assianma	nte		
	□ seminars and workshops			it assignine	1115				
Format of instruction	⊠ exercises			⊠ labo	oratory				
	<i>□ on line</i> in entirety				k with m	entor			
	□ partial e-learning				(othe	r)			
-	⊠ field work					,			
Studentresponsibiliti es	The presence on lec Performed all labora	tures in tory exe	the amo ercises re	unt of a quired.	t least 7	0 % of the t	imes so	chedu	iled.
Screening student	Class attendance	2,0	Researc	h		Practical tra	aining		
proportion of ECTS	Experimental work		Report			Individual w	vork		1.5
credits for eachactivity so that the total number of ECTS credits is equal to the ECTS	Essay		Seminar essay		Laboratory exercises		es	0,8	
	Tests	0,5	Oral exam		Preparation for laboratory exercises		es	0,2	
value of the course)	Written exam		Project			(Other)			
Grading and evaluating student work in class and at the final exam	There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm test and final tests consist of theoretical questions and numerical. The students that did not pass the midterm exams take part In the final exams. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises and 40 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula: Grade(%) = 0,1 NP + 0,1 LV + 0,4 (M1 + M2) the activities in percentage: NP - attendance at lectures, LV – laboratory assessment,								
		Title)			Number copies i the libra	of n o ry o	ailab ther	ility via media
Required literature (available in the library and via other	 I. Zanchi, Z. Blaž predavanja, FES 	ević: Ra B	adiokomu	inikacije),			e-lea poi	rning tal
media)	Boithias, L.: Radi Oxford Academic	io Wave : 1987.	Propaga	tion, No	orth	1			
	• Zentner, E.: Radi Zagreb, 1980.	iokomur	nikacije, S	Skolska	knjiga -	2			
Optional literature (at the time of submission of study programme proposal)	 Zentner, E.: Ante Parsons, J. D.: "T Publishers - Lond 	 Zentner, E.: Antene i radiosustavi, Graphis Zagreb, 2001. Parsons, J. D.: "The Mobile Radio Propagation Channel", Pentech Press Publishers - London, GB, 1992. 							

	 Doble, J.: "Introduction to Radio Propagation for Fixed and Mobile Communications", Artech House Boston - London, GB, 1996.
Quality assurance methods that ensure the acquisition of exit competences	 Evaluation of results in accordance with the above learning outcomes Feedback from students via surveys Self-evaluation of teachers Institutional and non-institutional evaluations
Other (as the proposer wishes to add)	

NAME OF THE COURSE	ALGORITHMS							
Code	FELJ12	Year of study	1.					
Course teacher	Matko Šarić, Ph.D., Assistant Professor	Credits (ECTS)	5					
Associate teachers	Ante Topić, TeachingAssistant	Type of instruction (number of hours)	S 0	AE 15	LE 15	DE 0		
Status of the course	Obligatory	Percentage of application of e-learning	0					
COURSE DESCRIPTION								
Course objectives	 Fraining students for: Design of efficient algorithms and analysis of algorithms properties (speed and memory) Adopting the practical knowledge about sorting algorithms and graph-based algorithms 							
Course enrolment requirements and entry competences required for the course	BsC degree.							
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - Analyze the execution - explain and apply diffe - explain and apply grap - apply dynamic progran	time of the algorithm rent sorting algorithms h-based algorithms nming						
Course content	Course content			L	or S	A ho	\E ours	
broken down in detail by weekly	Introduction. What are algo Example D-2 maximum	prithms. Analyzing algorith	ms in		3		0	
class schedule (syllabus)	Analyzing of the loops. Sol maximum - method of cros	ving of summations. Solvir sing the plane.	ng 2-D		3		0	
	Asymptotic notation. Limite	d rule.			3		0	

	The technique of diversecution time analy	ride and /sis).	rule. Me	rgesort	(pseudo	code,	3	0
	Recursion (search p Master theorem.	attern, i	teration,	recursic	on tree m	ethod).	3	0
	Heap data structure analysis).	Heaps	ort (pseu	docode	, executi	on time	3	0
	Quicksort (pseudoco	ode, exe	ecution tir	ne anal	ysis)		3	0
	The lower limit of so linear time. (counting	rting alg g sort, ra	jorithms e adix sort)	executio	on time. S	Sorting by	3	0
	The algorithms base definitions).	ed on gra	aphs (ba	sic conc	cepts and	ł	3	0
	Graph representatio adjacency list. BFS	n using algorithr	the adjao n.	cency m	natrix and	ł	3	0
	All pairs shortest par Warshall algorithm.	ths. Dyn	amic pro	grammi	ing. Floy	d-	3	0
	Longest common subsequence. Matrix chain multiplication					3	0	
	Decision problems. verification. NP com and Hamiltonian cyc	Decision problems. NP-problems and polynomial time /erification. NP completeness. Reduction. Hamiltonian path and Hamiltonian cycle.					3	0
	ist of laboratory or design exercises							LE hours
	Analysis of typical running times							2
	Solving of summation	าร						2
	Recursions							2
	Merge sort I							2
	Merge sort II							2
	Heap sort							2
	Quicksort							2
	Linear time sorting a	lgorithm	S					2
	Graph representatior	١						2
	BFS algorithm							2
	Floyd-Warshall algor	ithm						2
	Longest common su	osequer	nce					2
	Matrix chain multiplic	ation		1				2
Format of instruction	 ☑ lectures □ seminars and wo ☑ exercises □ on line in entirety 	rkshops	i	 □ independent assignments □ multimedia ⊠ laboratory 			nts	
	□ partial e-learning □ field work			□ wor	k with m (other	entor)		
Studentresponsibiliti es								
Screening student	Class attendance	2,0	Researc	ch		Practical tra	aining	
work (name the proportion of ECTS	Experimental work		Report			Individual w	/ork	2,2
credits for eachactivity so that	Essay		Semina essay	r		Laboratory	boratory exercises	

the total number of ECTS credits is	Tests	0,2	Oral exam		Preparation fo laboratory exe	r rcises		
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	lecturing and the second one is after the next 6 weeks. Midterm test and final test consist of theoretical questions and numerical problems. In the final exams students that did not pass the midterm exams take part. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises and 50 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula: Grade(%) = 0,5 (M1 + M2) the activities in percentage: • M1, M2 – test results. The final grade is defined in the next way: 50% do 63% sufficient (2) 64% do 77% good (3) 78% do 91% very good (4) 92% do 100% excellent (5) Number of copies in Availability via							
	Title Number of copies in the library							
		Title	•		Number of copies in the library	Availabi other r	ility via nedia	
Required literature (available in the	Individual work	Title			Number of copies in the library	Availabi other r e-learnin portal	ility via nedia g	
Required literature (available in the library and via other media)	Individual work Laboratory exercises	Title	•		Number of copies in the library	Availabi other r e-learnin portal	i lity via nedia g	
Required literature (available in the library and via other media)	Individual work Laboratory exercises Preparation for labor	Title	vercises		Number of copies in the library	Availabi other r e-learnin portal	i lity via nedia g	
Required literature (available in the library and via other media)	Individual work Laboratory exercises Preparation for labor	Title	kercises		Number of copies in the library	Availabi other r e-learnin portal	l ity via nedia g	
Required literature (available in the library and via other media)	Individual work Laboratory exercises Preparation for labor	Title	kercises		Number of copies in the library	Availabi other r e-learnin portal	g	
Required literature (available in the library and via other media) Optional literature (at the time of submission of study programme proposal)	Individual work Laboratory exercises Preparation for labor T.Cormen, C.Leisers secondedition, thirdp	Title a atory ex atory ex ator	kercises kivest, C.Stein: "I McGraw-Hill, 20	ntroduc 02	Number of copies in the library	Availabi other r e-learnin portal	g	
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	Individual work Laboratory exercises Preparation for labor T.Cormen, C.Leisers secondedition, thirdp - Evaluation of re - Feedback from - Self-evaluation - Feedback from	Title	ercises vercises vercises vivest, C.Stein: "I McGraw-Hill, 20 accordance with s via surveys ners s who have alrea	ntroduc 02 In the abo	Number of copies in the library	Availabi other r e-learnin portal ms", tcomes	g	

NAME OF THE COURSE	MOBILE COMMUNICATIONS									
Code	FELJ14	Year of study	1.							
Course teacher	Zoran Blažević, Ph.D., Full Professor	Credits (ECTS)	5							
Associate teachers	Maja Škiljo, Ph.D.	Type of instruction (number of hours)	L 30	S 0	AE 15	LE 15	DE 0			
Status of the course	Obligatory: 241 Elective: 242	Percentage of application of e-learning	<u> </u>							
	COURSE	E DESCRIPTION								
Course objectives	raining students for: understanding and application of basic principles of radio-networks, physical OSI layer of cellular radio-networks calculation and analysis, mobile radio networks analysis.									
Course enrolment requirements and entry competences required for the course	Finished the undergraduate study of Communications and Information Technology									
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: Calculate optimal radio system configuration in sense of selecting digital modulation and coding, model and perform basic calculation of cellular networks: base stations power and interference budget calculate and analyse (narrow- and wide-band) radio-channel parameters, conduct and analyse radio-channel measurements 									
	Course content					A hc	∖E ours			
	Introduction to Mobile Com	munications.			1		1			
	Classification of digital radi	o-channels.			2		1			
	Digital radio system perform	mances.			2		2			
	Systems with bandwidth lin	nitation.			2		1			
	Power limited systems.				2		1			
Course content	Power limited and bandwid	th limited systems. Chann	el codir	ng.	2		1			
broken down in	Direct Sequence-Spread S	pectrum Systems			2		1			
detail by weekly class schedule	Cellular radio systems. Coo interference.	channel and adjacent char	nnel		2		1			
(syllabus)	Path-loss law. Base station	ling budget. Multipath rec	eption.		2		2			
	First midterm exam									
	Cell radio-coverage calcula	ation.			2		1			
	Mobile propagation channe	el analysis.			2		1			
	Radio channel measureme	ents.			2		1			
	Propagation channel classification. Delay-spread and channel coherence bandwidth.				2		1			
	Second midterm exam									
	List of laboratory exercises					LEI	nours			
	Radio channel characteriza measurements.	tion by Vector Network An	alyser				5			

	Communication systems testing and simulating by Matlab and Simu						llink	2
	Analog and digital mo	odulatio	n simulat	ions				2
	Multipath fading char	nnels sir	nulations					2
	Adjacent and co-chann	el interfe	rence in c	ellular s	ystems s	imulations by Sin	nulink	2
	COST 207 and GSM	/EDGE	channel	models	by Matl	ab		2
Format of instruction	 ☑ lectures □ seminars and workshops □ exercises □ on line in entirety □ partial e-learning ☑ field work □ independent □ multimedia ☑ laboratory □ work with m □ (other 			nt assignments nentor r)				
Studentresponsibiliti es	The presence on lec Performed all labora	tures in tory exe	the amo ercises re	unt of a quired.	t least 7	0 % of the time	s sche	duled.
Screening student	Class attendance	2,0	Researc	ch		Practical traini	ng	
proportion of ECTS	Experimental work		Report			Individual work	K	1.5
credits for eachactivity so that the total number of	Essay		Semina essay	ſ		Laboratory exe	ercises	0,8
ECTS credits is equal to the ECTS	Tests	0,5	Oral exam		Preparation for laboratory exercises		0,2	
value of the course)	Written exam		Project			(Other)		
Grading and evaluating student work in class and at the final exam	I here are two midte lecturing and the sec tests consist of theo the midterm exams carried out as writt assessment of labor final exam. Grade (ir G the activities in perce • NP - attenda • LV – laborat • M1, M2 – tes	 There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm test and final tests consist of theoretical questions and numerical. The students that did not pass the midterm exams take part In the final exams. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises and 40 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula: Grade(%) = 0,1 NP + 0,1 LV + 0,4 (M1 + M2) the activities in percentage: NP - attendance at lectures, LV – laboratory assessment, M1, M2 – test results. 						
		Title)			Number of copies in the library	Availa othe	ibility via r media
Required literature (available in the	 Z. Blažević: Mob FESB 	ilne korr	nunikacije	e, preda	ivanja,		e-le p	earning ortal
library and via other media)	 I. Zanchi, Z. Blaž predavanja, FES 	ević: Ra B	adiokomu	inikacije	Э,		e-le p	earning ortal
	David Parson.: The Mobile Radio Propagation Channel, Pentech Press Pub. London, 1992.				2			
Optional literature (at the time of submission of study programme proposal)	 R. Steele: "Mobil IEEE Press, Pisc Vijag, K. Garg, Jo Systems, Prentic 	R. Steele: "Mobile Radio Communications", Pentech Press, London, GB and IEEE Press, Piscataway, USA, 1992. Vijag, K. Garg, Joseph, E. Wilkes: Wireless and Personal Communications Systems, Prentice Hall PTR, NY 1996.						

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

NAME OF THE COURSE	LOCAL AND ACCESS NETWORKS								
Code	FELH30	Year of study	2.						
Course teacher	Josip Lörincz, Ph.D., Assistant Professor	Credits (ECTS)	5						
Associate teachers	Dinko Begušić, Ph.D., Full Professor	Type of instruction (number of hours)	L 30	S 0	AE 0	LE 30	DE		
Status of the course	 Obligatory (university graduate programme, 242) 	Percentage of application of e-learning	10%						
	COURSE	E DESCRIPTION							
Course objectives	Training students for: - knowledge and understanding of the fundamental concepts of local and access networks, - knowledge of the characteristics of the medium for the transmission of information in local and access network (metal wires, optical fibre and wireless transmission), - capability to configure local and access networks and network devices, - qualification for participation in the design and maintenance of local and access networks, - permanent acquisition of knowledge in the field of new technologies used in local access networks								
Course enrolment requirements and entry competences required for the course	Knowledge of basic concepts and technology in the area of data information transfer and communication protocols. Knowledge of basic computer skills. Knowledge of English language.								
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: define basic terms and evaluate and implemen information in local and medias including metal configure local and according participate in the design permanently acquire kn access networks. 	 Students will be able to: define basic terms and concepts of local and access networks, evaluate and implement protocols, systems and techniques for transmission of information in local and access networks based on different transmission medias including metal wires, optical fibre and wireless transmission, configure local and access networks and network devices, participate in the design and maintenance of local and access networks, permanently acquire knowledge about new technologies in the area of local access networks 							

	Course content		L hours	AE hours		
	Introduction. Standards.		nouro	2		
	The division of the LAN network acco	ording to different criteria.		2		
	Local area networks of type Ethernet.			2		
	Local area networks of type: Token ri DQDB	ng, Token bus, FDDI,		2		
Course content	Gigabit Ethernet, switched LAN			2		
detail by weekly	Networks: ATM, ATM LAN			2		
class schedule	Virtual Private Networks-VPN		2			
(syllabus)	Wireless Communication Systems-ge		2			
	Wireless LAN (WLAN) networks			2		
	Broadband access networks-general		2			
	xDSL technology: HDSL, ADSL, VDS		2			
	Fiber optical networks: FTTx technolo		2			
	HFC technology, WiMAX technology		2			
			LEhours			
	Exercise 1.: Introduction - basics Rive	rbed Modeler simulator		2		
	Exercise 2.: Local Area Network - The role of Switch in LAN Ethernet					
	Exercise 3.: Local Area Network - a network design (planning network with different users, terminals and services)					
	Exercise 4.: ATM (cell switching technology based on connection oriented connections)					
	Exercise 5.: RIP protocol (Routing protocol based on an link algorithm state)					
	Exercise 6.: TCP Transmission Contro on pre-established links)	ol Protocol (Trusted protoco	ol based	2		
	Exercise 7.: The methods of sorting (c discard packets)	queuing, waiting to transmit	t or	2		
	Exercise 8.: The wireless local area n mobile station)	etwork (media access cont	rol for	2		
	Exercise 9.: Mobile wireless networks mobile devices)	(wireless cellular networks	s with	2		
	Exercise 10.: OSPF routing protocol b	ased on an link-state algor	rithm	2		
	Exercise 11.: Border Gateway Protoco between different administrative doma	ol (BGP) - (Routing data tra ains)	affic	2		
	Compensation exercises			2		
Format of instruction	Image: Sector of instruction Image: Sector of instruction Image: Sector of instruction Image: Sector of instruction					
	\Box field work					

	Theconditions for ov	erallpos	itiveassessment	are:				
Studentresponsibiliti es	 positive assessr minimum preser presence on lab time in a semest minimum 50% p commission exa 	 positive assessment of laboratory exercises (above 50 %) minimum presence during 70% of overall class teaching time in a semester, presence on laboratory exercises during 100% of overall laboratory exercise time in a semester, minimum 50% points at each mid-term or final exam (or correctional or commission exam). 						
Screening student	Class attendance	1,0	Research		Practical traini	ng		
work (name the	Experimental work		Report		Independent w	/ork	2,2	
credits for eachactivity so that	Essay		Seminar essay		Laboratory exe	ercises	1,0	
the total number of ECTS credits is equal to the ECTS	Tests		Oral exam		Preparation for Laboratory exe	r ercises	0,5	
value of the course)	Written exam	0,3	Project		(Other)			
Grading and evaluating student work in class and at the final exam	During the semester will be after 8 weeks and 2nd of the final of they did not pass or (correctional) exam, Rating (%) = 0.1PL - PL – presence on th LA- grades from labo M1, M2- the 1st and percentage), The final grade is de percentage Rating 50% to 61% is suffic 62% to 74% good (3 75% to 87% of very 88% 100% Excellent Independently on rea and 4 th final (correction the case of organiza curricula content. Rea (commission) exam Examinations: 1 st Final exam 3 rd Final (correction 4 th Final (correction 5 th Final (commission specific academic yee	there wiss of class exams, some student + 0,2LA e lecture oratory a 2nd mid etermine determine isent (2) good (4 t (5) sults obtise tion of c equirement is a pos	<pre>ill be two mid-terr ses, and the 2nd students take exa of the mid-term s take exam of c + 0.35 (M1 + M2 es (expressed in assessment (exp d-term exam grad d as follows:) tained during the cams students ta commission exam ents related to th itive assessment itive assessment</pre>	n exama l after 1 am of th exams. omplete) percent ressed des or fi des or fi labo based of	s (tests). The 1s 5 weeks of cla hose parts of th On the 3rd an e course curricu tage), in percentage), nal exam grade	ams, on the curricula dath of tala.	m exam the 1st a which he final ssed in ssed in the 3 rd ent. In tire ional	
Required literature		Title)		Number of copies in	Availabi other r	lity via nedia	
(available in the library and via other media)	 Milutin Kapov, Jo Networks", FESE script 	osip Lori 3-Split, 2	ncz, "Local and A 2015, (2009), inte	Access ernal		e-lear por	ning tal	

	 Josip Lorincz, "Instructions for performing laboratory exercises in local and access networks", FESB Split, internal script, 2015. 		e-learning portal				
	 Alen Bažant and others: "The basic architecture of the network", ELEMENT, Zagreb, 2004. 	5					
	 M. Vrdoljak and others: "New Communication Technologies", FESB Split, HT TKC Split, softcore library Split in 1999. 	5					
Optional literature (at the time of submission of study programme proposal)	 M. Jose ., M. Caballero and others, "SDH / SONE Synchronization Networks", Artech House, Boston Alex Gillespie: "Broadband Access Technology In Artech House, Boston, London, 2000. Annabel Z. Dodd, "Telecommunications", Algorith 	M. Jose ., M. Caballero and others, "SDH / SONET, ATM, xDSL and Synchronization Networks", Artech House, Boston, London, 2003. Alex Gillespie: "Broadband Access Technology Interfaces and Management, Artech House, Boston, London, 2000. Annabel Z. Dodd, "Telecommunications", Algorithm, Zagreb 2002					
Quality assurance methods that ensure the acquisition of exit competences	Evaluation of results in accordance with the above learning outcomes Feedback from students via surveys Self-evaluation of teachers Institutional and non-institutional evaluations Feedback from graduated students about the relevance of the course content						
Other (as the proposer wishes to add)	1						

NAME OF THE COURSE	BIOELECTROMAGNETICS									
Code	FELJ24	Year of study	1.							
Course teacher	Antonio Šarolić, Ph.D., Full Professor	Credits (ECTS)	5							
Accesiote teachers	Niko Ištuk, Teaching	Type of instruction	L	S	AE	LE	DE			
Associate teachers	Assistant	(number of hours)	30			30				
Status of the course	Elective	Percentage of application of e-learning	0							
	COURSE	E DESCRIPTION								
Course objectives	Training students for: - understanding the hum - acquiring knowledge of - application of specializ	nan electrophysiology n therapeutic and diagnos ed interdisciplinary knowle	tic met	hods biome	dical	applica	ations			
Course enrolment requirements and entry competences required for the course	None.									
Learning outcomes expected at the level	Students will be able to: - describe the cell struct	ure								

of the course (4 to	- describe the elec	describe the electrophysiology of excitable cells and tissues						
10 learning outcomes)	 apply the electro function 	physiol	ogy know	ledge fo	or undei	rstanding the	e brain an	d heart
	- analyze the elec	tric activ	ity of hea	art and	brain wi	th application	ns in diag	nostics
	- link the electroph	nysiolog	y principl	es to th	e functi	on of other b	odily orga	ans and to
	potential biomed	lical app	lications					
	Course content						L hours	AE hours
	Introduction and hist	ory.					2	0
	Structure of neuron a	and mus	scle cells				2	0
	Membrane potential.						2	0
	Axon as transmissio	n line (c	able).				2	0
Course content	Membrane activation	٦.					2	0
broken down in	Synapses, receptors	and bra	ain.				2	0
detail by weekly	Heart.						2	0
class schedule (svllabus)	Volume source. Volume conductor. 2						2	0
(0)10000)	Electrocardiography (ECG).					2	0	
	Electroencephalograhpy (EEG).					2	0	
	Electrophysiology of	the eye	. Electro	dermal	reaction	•	2	0
	Other diagnostic and therapeutic methods based on applied electromagnetics. Magnetic resonance imaging (MRI).				applied I).	2	0	
	Visit to Medical Scho companies related to	Visit to Medical School of the University of Split. Visit to companies related to the course topics.					0	
	List of laboratory or o	design e	exercises					LE hours
	Membrane potential.							4
	Axon as transmissior	n line (ca	able).					2
	Membrane activation							4
	Synapses, receptors	and bra	in.					2
	Electrocardiography	(ECG).						2
	Electroencephalogra	hpy (EE	G).					2
	Electrodermal reaction	on.						2
	Other diagnostic and electromagnetics. Ma	therape agnetic i	eutic meth resonanc	nods ba e imagii	sed on and ng (MRI	applied).		2
	Visit to Medical Scho related to the course	ol of the topics.	Universi	ity of Sp	olit. Visit	to companie	es	6
	⊠ lectures							
	Seminars and wor	kshops			penden	t assignmen	ts	
Format of instruction	⊠ exercises			⊔ muit	imedia			
Format of instruction	□ <i>on line</i> in entirety				vialory	ontor		
	□ partial e-learning			□ work with mentor				
	\boxtimes field work	i field work □ (other)						
Student responsibilities	Student is required to least 70% of the sch the amount of 100% laboratory exercises	o attenc edule. S of the s	I the lectu Student is schedule	res and require and to c	d audito ed to atte complete	ry exercises end the labo e all tasks as	in the am ratory exe sociated	ount of at ercises in with
	Class attendance	1	Researc	:h		Practical tra	ining	

Screening student	Experimental work	0,5	Report		Laboratory exe	ercises	0,5
proportion of ECTS credits for each	Essay		Seminar essay	1	Individual work	ζ.	1
activity so that the total number of	Mid-exam	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 the middles of the s exercises are compl The first mid-exam is exam is based on th To pass at each mid exam containing nu 50% of points must from the lectures). To earn the right to earned from the par from auditory exercis first mid-exam conta If a student earns th have passed the wh exams. At the first exam tern half of the material th At all other exam tern material. Approaching the e responsibilities. The overall point per of points earned in a Percentage -> Grad 50% - 62,4% -> suff 62,5% - 74,9% -> go 75% - 87,4% -> very 87,5% - 100% -> exe Final grade can be individual and exper Exam terms: accord	r, two mi semeste eted, sc s based e first se d-exam, merical be earne approa t of the ses) and ining the ses) and ining the positi- nole exam m, stude hat they ms, stud exams is rcentage icient (2) ood (3) y good (4) cellent (5) suppler imental ing to th	id-exams will be r, while the sec hedules to be ag on the first half of econd half of the min. 50% of poin problems (mate ed from the part ch the second r first mid-exam c a min. 30% of point eory (material from ve grades on bock m with the grade ents may choose haven't passed ents must take the s subject to fur e defining the over questions, correct () 4) 5) mented by perform work, in agreeming e academic year	held. T ond will greed wi of the co course nts mus erial fror of the e nid-exal containin ints mus om the le oth mid- e calcula e to take at mid-e ne whole ulfilling erall gra cted by	he first mid-exa be held after th the students. ourse material. t be earned from a uditory exer xam containing m, min. 30% of g numerical pro- st be earned fro- ectures). exams, he/she ated as average e the exam con- exams. e exam, containing the requiremend the requiremend the result of oraction practical project the teacher. ar	Im will be the lectur The secon m the par rcises) ar theory (r f points n oblems (r m the par is consid e from bo ntaining of ing all the ents on d as the a al verifica	held in res and nd mid- rt of the nd min. naterial nust be naterial rt of the lered to th mid- nly that course student average tion:
	.	Title)		copies in the library	Availabi other r	lity via nedia
Required literature (available in the library and via other	 Jaakko Malmivuo Bioelectromagne Applications of B Fields, Oxford Un 1995. 	o & Robe etism - P ioelectri niversity	ert Plonsey: rinciples and c and Biomagne Press, New Yor	tic k,			
library and via other media)	Handbook of biol electromagnetic Bioengineering a Electromagnetic and Ben Greene	logical e fields (th Ind Biop Fields, I baum, C	ffects of hird edition): hysical Aspects Ed. Frank S. Bar CRC Press, 2007	of nes ′.			
	Handbook of biolelectromagnetic	logical e fields (th	ttects of hird edition): Biol	ogical			

	and Medical Aspects of Electromagnetic Fields, Ed. Frank S. Barnes and Ben Greenebaum, CRC Press, 2007.	
Optional literature (at the time of submission of study programme proposal)	 Šantić, A: Biomedicinska elektronika, Školska knjiga, Zagreb, 1995. The Biomedical Engineering Handbook (Second Edition), Ed. Joseph D. Bronzino, CRC Press, 2000. 	
Quality assurance methods that ensure the acquisition of exit competences	Surveys providing student feedback	
Other (as the proposer wishes to add)		

NAME OF THE COURSE	MEDICAL DEVICES							
Code	FELH18	Year of study	2.					
Course teacher	Antonio Šarolić, Ph.D., Full Professor Ivan Marinović, Ph.D., Full Professor	Credits (ECTS)	5	5				
Associate teachers	Niko Ištuk mag ing el	Type of instruction	L	S	AE	LE	DE	
	ruke lotak, mag. mg. en	(number of hours)	30			30		
Status of the course	Elective	Percentage of application of e-learning	0					
	COURSE	E DESCRIPTION						
Course objectives	 learning the types, realizations and application areas of electronic/communication/information technology in medical domain knowledge on therapeutic, diagnostic and control medical electronic devices understanding the specifics of functional and safety requirements for medical electronic devices understanding and application of success criteria for medical device innovation 							
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: employ their knowledge analysis and developme use the knowledge of h analysis and developme analyze the component human body medical el conceive the electronic 	e on electronic/communica ent of medical devices uman physiology, especia ent of medical devices s of medical electronic devices ectronic devices circuits for application in a	tion/inf Ily elec vices a i medic	ormati trophy nd the cal dev	on teo siolog ir intei ice	chnolog y, for raction	gy for with	

	 characterize a medical electronic device from the aspect of safety critically assess the success of innovation and development of a medical device 							
	Course content					•	L	AE
							hours	hours
	Basics of human ele	ctrophy	siology a	nd elec	trophysi	ology	2	0
	Measurement medic	al electi	ronic dev	ices			2	0
	Diagnostic medical e	2	0					
	Therapeutic medical	2	0					
	Electronic circuits ar	6	0					
	Circuits and devices frequencies	for elec	tric and r	nagnet	ic stimu	ation at low	2	0
	Circuits and devices	for ther	mal proc	edures	at high	frequencies	2	0
	Electrical safety asp aspects of medical e	ects and electroni	d electror c devices	nagneti s	c compa	atibility	2	0
Course content broken down in detail by weekly class schedule (syllabus)	Control and auxiliary Theranostic medical therapeutics and dia methods	v medica electroi gnostics	al electron nic device s in innov	nic devi es – uni ative m	ces. E-ł ifying th iedical c	Health. e levices and	2	0
	Translational resaerd from lab to clinics (fr Assessment of clinic technology (Health	ch and c om the al and e rechnolo	developm workbenc conomic ogy Asse	ent of r ch to the efficac ssment	medical e bedsic y of me - HTA)	devices le). dical	2	0
	Clinical studies: principles and implementation of clinical trials of medical devices						2	0
	List of laboratory or	design e	exercises					LE hours
	Basics of human elec	ctrophys	iology					2
	Amplifier circuits							4
	Electrostimulator circuits							4
	Noise and disturbance suppression in electronic devices							2
	Electromagnetic compatibility testing							2
	Electrical safety testing							2
	Measurements of dielctric properties of tissues							2
	Measurement, diagnostic and therapeutic medical electronic devices – field trip (visit to medical establishments)							8
	⊠ lectures			□ ind	anondor	t occianmon	to	
	\boxtimes seminars and wo	rkshops			epender	it assignmen	15	
	⊠ exercises							
Format of Instruction	□ on line in entirety							
	□ partial e-learning			∐ wor	K WITH N	nentor		
	⊠ field work				(othe	er)		
Student responsibilities	Student is required t least 70% of the sch	o attenc edule.	the lectu	ures and	d audito	ry exercises	in the arr	nount of at
Screening student	Class attendance	1	Researc	h		Practical tra	ining	
proportion of ECTS	Experimental work	0,5	Report			Laboratory e	exercises	0,5
activity so that the	Essay		Seminal essay	·	1	Individual w	ork	1
ECTS credits is	Mid-exam	0,5	Oral exa	am		(Othe	er)	
value of the course)	Written exam	0,5	Project			(Othe	er)	
Grading and evaluating student	Lectures are given in Marinović (1/3 of lec	n collabo ture hou	oration of irs).	prof. Š	arolić (2	2/3 of lecture	hours) a	nd prof.

work in class and at the final exam	Exam: presentation and defense of the seminar essa	у						
	Title	Number of copies in the library	Availability via other media					
Required literature (available in the library and via other media)	Ante Šantić: Biomedicinska elektronika, Školska knjiga, Zagreb, 1995.							
	Jaakko Malmivuo & Robert Plonsey: Bioelectromagnetism - Principles and Applications of Bioelectric and Biomagnetic Fields, Oxford University Press, New York, 1995.							
Optional literature (at the time of submission of study programme proposal)	 Handbook of biological effects of electromagnetic Bioengineering and Biophysical Aspects of Electrom Barnes and Ben Greenebaum, CRC Press, 2007. Handbook of biological effects of electromagnetic fie Medical Aspects of Electromagnetic Fields, Ed. Fran Greenebaum, CRC Press, 2007. The Biomedical Engineering Handbook (Second Edi CRC Press, 2000. 	Handbook of biological effects of electromagnetic fields (third edition): Bioengineering and Biophysical Aspects of Electromagnetic Fields, Ed. Frank S. Barnes and Ben Greenebaum, CRC Press, 2007. Handbook of biological effects of electromagnetic fields (third edition): Biological and Medical Aspects of Electromagnetic Fields, Ed. Frank S. Barnes and Ben Greenebaum, CRC Press, 2007. The Biomedical Engineering Handbook (Second Edition), Ed. Joseph D. Bronzino,						
Quality assurance methods that ensure the acquisition of exit competences	Surveys providing student feedback							
Other (as the proposer wishes to add)								

NAME OF THE COURSE	MULTIMEDIA SYSTEMS							
Code	FELJ20	Year of study	2.					
Course teacher	Mladen Russo, Ph.D., Assistant Professor	Credits (ECTS)	5					
	Jelena Čulić, Teaching	S	AE	LE	DE			
Associate teachers	Assistant Martina Bašić, Teaching Assistant	l ype of instruction (number of hours)	30	0	0	30	0	
Status of the course	Obligatory: 242 Elective: 241	Percentage of application of e-learning	0					
	COURSE	E DESCRIPTION						
Course objectives	 Training students for: understanding of multin knowledge of the prope and video signals (inclu understanding of the m image and video signal 	 raining students for: understanding of multimedia systems and virtual reality knowledge of the properties and methods for generating speech, audio, image and video signals (including 3D images and video) understanding of the most important algorithms for compressing speech, audio, image and video signals 						
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: describe the basic principles of human speech, hearing and vision explain the basic principles of psychoacoustics and their application in compression of audio signals demonstrate the frequency masking effect define the most important algorithms for compression of speech, audio, image and video signals 							
	Course content			ł	L nours	/ hc	AE ours	
	Introduction. History of mul Overview of multimedia so applications.	I	2		0			
	Audio signal. How humans modelling.	hear and speak. Speech			2		0	
Course content	Generic compression tech specific algorithms (mp3).	niques for audio signals. A	udio		2		0	
detail by weekly class schedule (syllabus)	Speech specific algorithms and applications in mobile encoding speech and audio	(LPC, CELP, RELP, MPE telephony. Review of stand o signals.	, RPE) dards fo	or	2		0	
	Color in images and video signal. The perception of color (how people perceive electromagnetic radiation). Theory of mixing colors.						0	
	Color models for image sig models for video signal (YU color models (HSB, HLS, H signal (resolution, depth, m formats (gif, tiff, jfif, ps, bm	ed	2		0			

	Basics of video and Digital television and requirements.	televisio I video.	on. Analo Video for	g televis mats a	sion and video nd memory).	2	0
	Image compression.	JPEG I	modes.				2	0
	Video compression:	H.261.	H.263.				2	0
	Video compression:	Video compression: MPEG-1. MPEG -2.						0
	Video compression:	MPEG-	4.				2	0
	Video compression:	H.264.					2	0
	Fundamentals of virt vision. Software and	undamentals of virtual reality. History. Stereoscopic (3D) 2 ision. Software and hardware for virtual reality.						0
								LE hours
	Sound recording. Sea	arching	of voiced	and ur	voiced speec	h. Pitch	n period.	2
	Speech specific algo	rithms (LPC)					2
	Frequency masking							2
	3D sound							2
	Image compression ((JPEG)						2
	Image compression ((JPEG)						2
	Image compression ((JPEG)						2
	MPEG – influence of	I, P, B	rames or	n video	quality			2
	Multimedia systems o	on mobi	le device	s (Andr	oid programm	ing)		2
	Multimedia systems o	on mobi	le device	s (Andr	oid programm	ing)		2
	Multimedia systems o	on mobi	le device	s (Andr	oid programm	ing)		2
	3D images							2
	CAVE system							2
Format of instruction	 lectures seminars and work exercises on line in entirety partial e-learning field work 	rkshops		 □ inde □ mul ⊠ labo □ wor □ 	ependent assi timedia pratory k with mentor (other)	gnment	S	
Studentresponsibiliti es	The presence on lec Performed all require	tures in ed labor	the amo atory exe	unt of a ercises.	t least 70 % o	f the tin	nes sche	eduled.
Screening student	Class attendance	3	Researc	h	Pract	ical trai	ning	
work (name the proportion of ECTS	Experimental work		Report		Indivi	dual wo	ork	1,7
credits for eachactivity so that the total number of	Essay		Semina essay	r		(Othe	r)	
ECTS credits is	Tests	0,2	Oral exa	am		(Othe	r)	
equal to the ECTS value of the course)	Written exam	0,1	Project			(Othe	r)	
Grading and evaluating student work in class and at the final exam	During a semester th are held according to from the complete of take the midterm th students take the tes The requirement for exam. Grade (in per	/ritten exam 0,1 Project (Other) uring a semester there are two midterms and final exam. Final exam and reheld according to the calendar of classes. At the final exam students take om the complete course if they do not have a positive grade on the midtake the midterm that they did not pass. At the make-up and commission to the take the test from the complete course. he requirement for passing grade is 50% points on each midterm exam or ware.						I midterms ke the test idterms or sion exam or the final

	Grade(%) = 0,5*M1+0,5*M2; M1, M2 - midterm test	Grade(%) = 0,5*M1+0,5*M2; M1, M2 – midterm test results.						
	The final grade is determined as follows:							
	Percentage Grade							
	50% to 61% sufficient (2)	% to 61% sufficient (2)						
	62% to 74% good (3)							
	75% to 87% very good (4)							
	88% to 100% excellent (5)							
Required literature (available in the	Title	Number of copies in the library	Availability via other media					
media)	H. Dujmić: Multimedijskisustavi, internal script	1	e-learning portal					
Optional literature (at the time of submission of study programme proposal)	 Steinmetz, Nahrstedt: "Multimedia Fundamentals Processing", Prentice Hall, 2002 Rao, Bojkovic, Milovanovic: "Multimedia Commun StandardsandNetworks", Prentice Hall, 2002 	: Media Coding	gandContent ns: Techniques,					
Quality assurance	- Evaluation of results in accordance with the abov	e learning out	comes					
methods that ensure	- Feedback from students via surveys							
the acquisition of	- Self-evaluation of teachers							
exit competences	- Institutional and non-institutional evaluations							
Other (as the proposer wishes to add)								

NAME OF THE COURSE	MEASUREMENTS IN WIRELESS SYSTEMS								
Code	FELJ22	Year of study	2						
Course teacher	Zoran Blažević, Ph.D., Full Professor	Credits (ECTS)	5						
Associate teachers	Maja Škiljo, Ph.D.	Type of instruction (number of hours)	L 30	S 0	AE 15	LE 15	DE 0		
Status of the course	Obligatory: 241 Elective: 242	Obligatory: 241 Percentage of application of e-learning 0							
	COURSE	DESCRIPTION	0						
Course objectives	 Training students for: radio-channel measure statistical modelling of various radio systems, applying empirical and 	raining students for: radio-channel measurements and analysis, statistical modelling of radio propagation in different environments and for various radio systems,							
Course enrolment requirements and entry competences required for the course	Finished the undergraduate	Finished the undergraduate study of Communications and Information Technology							
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	 Students will be able to: calculate radio-channel parameters, perform measurements and analysis of fixed and mobile radio systems parameters statistically characterize radio propagation of arbitrary radio-systems on the base of measurements, Apply various chappel models 								
	Course content			ł	L nours	A ho	\E ours		
	Introduction to Measureme	nts in Wireless Systems.			1		1		
	Fixed radio-links channel parameters. Fading						1		
	Ground radio links planning and measurements						2		
	Fading in mobile radio chai	nnels.			2		1		
	Mobile radio channel parar	neters.			2		1		
	Propagation path-loss mod	lels. Hata-Okumura model			3		1		
Course content	First midterm exam								
broken down in detail by weekly	Statistical channel models with Maxwell theory based	of ground networks compa model.	arison		2		1		
class schedule (syllabus)	Satellite radio-channels. St measurements (Loo model	atistical models based on , Suzuki model).			4		1		
	Wide-band channel parame	eters. Wide-band measure	ements.		4		3		
	Wide-band channel models	s based on measurements			2		1		
	Wide-band indoor radio channel modelling. 3						1		
	Second midterm exam								
	List of laboratory exercises					LE	nours		
	Antenna measurements by Vector Network Analyser measurements. Measurements calibration.						3		
Narrow-band channel measurements at various frequencies.							3		

	Wide-band channel r	neasure	ements				3	
	Wide-band indoor ch	annel m	easurem	ents			3	
	Radio-links planning	by using	g measur	ed data and so	ftware.		3	
Format of instruction	 ☑ lectures ☑ seminars and workshops ☑ exercises ☑ on line in entirety ☑ partial e-learning ☑ field work 			 independent assignments multimedia laboratory work with mentor (other) 				
Student responsibilities	The presence on lec Performed all labora	tures in tory exe	the amorer the second	unt of at least 7 quired.	0 % of the time	es schedu	uled.	
Screening student	Class attendance	2,0	Researc	h	Practical traini	ng		
work (name the proportion of ECTS	Experimental work		Report		Individual work	ĸ	1.5	
credits for each activity so that the	Essay		Seminar essay		Laboratory exe	ercises	0,8	
total number of ECTS credits is equal to the FCTS	Tests	0,5	Oral exa	ım	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	lecturing and the sec tests consists of theo the midterm exams carried out as writt assessment of labor final exam. Grade (ir G the activities in perce • NP - attenda • LV – laborat • M1, M2 – tes	 There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm test and final tests consists of theoretical questions and numerical. The students that did not pass the midterm exams take part In the final exams. The midterm and final exams are carried out as written tests. The requirement for passing grade is the positive assessment of laboratory exercises and 40 % points on each midterm exam or the final exam. Grade (in percentage) is formed according to the formula: Grade(%) = 0,1 NP + 0,1 LV + 0,4 (M1 + M2) the activities in percentage: NP - attendance at lectures, LV – laboratory assessment, M1, M2 – test results. 						
		Title	•		Number of copies in the library	Availab other	ility via media	
Required literature (available in the	 Z. Blažević; Mjer predavanja 	enja u b	ežičnim s	sustavima,		e-lea poi	rning rtal	
library and via other media)	 M. Patzold: "Mob 2002. 	oile Fadi	ng Chanr	nels", Wiley,	1			
	 Doble, J.: "Introd Fixed and Mobile House Boston - I 	uction to Comm _ondon,	o Radio F unication GB, 199	Propagation for s", Artech 6.	1			
Optional literature (at the time of submission of study programme proposal)	 G. H. Bryant: "Pr Zentner, E.: Ante 	inciples ene i rad	of Microv iosustavi	wave Measurer , Graphis Zagre	nents", IEE Pu eb, 2001.	blishing,	1993.	
Quality assurance methods that ensure	 Evaluation of res Feedback from s Self-evaluation c 	sults in a students of teach	accordano s via survo ers	ce with the abo eys	ve learning out	comes		

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

NAME OF THE COURSE	SYSTEMS FOR WIRELESS TRANSMISSION OF ENERGY							
Code	FELJ36	Year of study	2					
Course teacher	Zoran Blažević, Ph.D., Full Professor	Credits (ECTS)	5	5				
Associate teachers	Maja Škiljo, Ph.D.	Type of instruction (number of hours)	L 30	S 0	AE 0	LE 30	DE 0	
Status of the course	Elective	Percentage of application of e-learning	0					
	COURSE	E DESCRIPTION	-					
Course objectives	Training students for: - understanding of basic principles of and problemacy of systems for wireless transmission of energy, - designing of radio system for near-field transmission of energy - design of radio system for far-field power transmission - calculation and analysis of wireless energy systems parameters						3S	
Course enrolment requirements and entry competences required for the course	Finished the undergraduate study of Communications and Information Technology.							
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	Students will be able to: - analyse power and ene - calculate and estimate - designing basic transm	ergy transmission techniqu wireless energy transmiss hission system schemes fo	ies, sion syst or given :	tem p servic	aramet :e	ers,		
	Course content			ł	L nours	A ho	λE burs	
Course content	Introduction. Historical perstransmission.	spective of radio and wirel	ess		2			
broken down in detail by weekly class schedule (syllabus)	Principles and techniques f Transformers and resonan electrically small antennas.	for radio-transmission of e t transformers (Tesla Coil)	nergy. , and		4			
	Antenna scattering matrix. Coupled-Mode Theory and Spherical Mode Theory-Antenna Model application to wireless transmission of energy systems.							

	Rectennas.						2	
	Near-field energy an transformer.	Near-field energy and power transmission. Resonant transformer.						
	Far-field power tran	sfer.					4	
	Ground energy tran	sfer by	far-field s	ystems	concep	t	3	
	Satellite energy trar	nsfer sy	stem con	cept			3	
	Norms and standard standard.	ds for w	ireless er	nergy tr	ansfer. (Qi	2	
	Electromagnetic Com	patibility	of wireles	s energy	rtransfer	systems.	2	
	Interference probler and radio systems f	n betwe or wirel	en radio ess enero	-commι gy trans	inication fer.	is systems	2	
	Midterm exam	/idterm exam						
	List of laboratory exe	ercises						LE hours
	Measurements and a antennas	adjustme	ents of ind	ductivel	y fed ele	ectrically sm	all	8
	Measurements of tra Oscilloscope	nsfer pe	erformanc	es by S	Spectrum	n Analyser, a	and by	8
	Measurements of tra	nsfer pe	erformanc	es by ∖	ector N	etwork Anal	yser	6
	Tesla Coil Measurem	nents.						8
Format of instruction	 lectures seminars and wor exercises on line in entirety partial e-learning field work 	 ☑ lectures ☑ seminars and workshops ☑ exercises ☑ on line in entirety ☑ partial e-learning ☑ (other) 				t assignmen entor r)	its	
Student responsibilities	The presence on lec Performed all labora	tures in tory exe	the amo ercises re	unt of a quired.	t least 7	0 % of the ti	mes sche	duled.
Screening student	Class attendance	1.5	Researc	h		Practical tra	aining	
work (name the proportion of ECTS	Experimental work		Report			Individual w	vork	2
credits for each activity so that the	Essay		Semina essay	•		Laboratory	exercises	0,8
total number of ECTS credits is equal to the ECTS	Tests	0,5	Oral exa	am		Preparation laboratory e	for exercises	0,2
value of the course)	Written exam		Project			(Oth	er)	
Grading and evaluating student work in class and at the final examThere are one midterm and one final exam. Both midterm test and to of theoretical questions and numerical problems. The students that midterm exams take part In the final exams. The midterm and final ex out as written tests. The requirement for passing grade is the positive laboratory exercises, 40 % points on the midterm exam or the final rest of the grade depends on the seminary work presented by the str percentage) is formed according to the formula: Grade(%) = 0,1 NP + 0,1 LV + 0,4 (M + S) the activities in percentage: NP - attendance at lectures, LV – laboratory assessment,				nd final te hat did no al exams a sitive asse final exan e student.	est consist t pass the are carried ssment of n, and the Grade (in			
	 M – test rest 	ults.,						

S – seminary work results and presentation			
Required literature (available in the library and via other media)	Title	Number of copies in the library	Availability via other media
	 Ki Young Kim (editor), "Wireless Power Transfer-Principles and Engineering Explorations", InTech, January 2012. 		e-learning portal
	 Volakis J., C. C. Chen and K. Fujimoto, "Small antennas: miniaturization techniques and applications", New York, McGraw-Hill, 2010. 		e-learning portal
	 Special issue "Solar Power Satellite and Wireless Power Transmission", IEEE Microwave Magazine, Vol. 3, No. 4, December 2002. 	1	
Optional literature (at the time of submission of study programme proposal)	 Lee J. and S. Nam, "Fundamental aspects of near-field coupling small antennas for wireless power transfer", IEEE Trans. Antennas Propag., Vol. 58, No. 12, 3442-3449, 2010. P. Sample, D. T. Meyer, J. R. Smith: Analysis, experimental results, and range adaptation of magnetically coupled resonators for wireless power transfer, IEEE Transactions on Industrial Electronics, Vol. 58, No. 2, 2010, p.p 544-554. N. Tesla, A. Marinčić: Colorado Springs Notes, Nolit, Beograd, 1978. Carol Gray Montgomery, Robert Henry Dicke and Edward M. Purcell, "Principles of microwave circuits", McGraw-Hill Book Company, Inc., USA, 1948. 		
Quality assurance methods that ensure the acquisition of exit competences	 Evaluation of results in accordance with the above learning outcomes Feedback from students via surveys Self-evaluation of teachers Institutional and non-institutional evaluations 		
Other (as the proposer wishes to add)			