1.	Course title	**Advanced bioinformatical data visualization techniques**	
2.	Course code	BIO-I-10	
3.	Study program	**Master studies of Information Science and Computer Engineering - Bioinformatics**	
4.	Unit offering the course	**FCSE**	
5.	Undergraduate/master/PhD	**Master**	
6.	Year/semester 2/summer/elective	7. ECTS: **6**	
8.	Teacher(s)	Prof. dr. Suzana Loshkovska / assoc. prof. dr. Dejan Gjorgjevikj	
9.	Course prerequisites	None	
10.	Goals (learning outcomes): Upon completion of the course, the student will be able to use the techniques for visualization of the bioinformatics data, to develop web-services for bioinformatics application and to apply techniques for visualization of research simulation results.		
11.	Course content: In the framework of the course, the standard data visualization techniques will be presented. The visualization of DNA, RNA and protein structures will be specially emphasized. The course covers fundamentals of computer graphics and web services as the basic building elements of modular information systems; building geometric models of bioinformatics data: representation of curves and surfaces, surface optimization, visualization: techniques for designing, rendering the surfaces: textures, volume rendering, composite rendering. Programming the ActiveX components for web based representation of 3D objects. SOA architectures. The basic architecture of web services. Publishing web services. Integration of web services in the application user-interface.		
12.	Teaching methods: Lectures supported by slide presentations, interactive lectures, trainings (using lab equipment and software packages), team work, case studies, invited guests and lectures, individual practical assignments presentations, seminar paper, e-learning (forums, consultations).		
13.	Total available time	6 ECTS x 30 hours = 180 hours	
14.	Distribution of the available time	100+0+80 = 180 hours	
15.	Teaching activities	15.1.	Lectures	100 hours
		15.2.	Training (labs, problem solving), seminar and team work	0 hours
16.	Other activities	16.1.	Project work	20 hours
		16.2.	Self study	20 hours
		16.3.	Home work	30 hours
17.	Grading			
	17.1.	Tests		65 points
	17.2.	Seminar work/project (written or oral presentation)		25 points
	17.3.	Active participation		10 points

		to 59 points	5 (five) (F)	
18.	Grading criteria	from 60 to 68 points	6 (six) (E)	
		from 69 to 76 points	7 (seven) (D)	
		from 77 to 84 points	8 (eight) (C)	
		from 85 to 92 points	9 (nine) (B)	
		from 93 to 100 points	10 (ten) (A)	
19.	Final exam prerequisites	Successfully completed activities 15.1 and 15.2		
20.	Course language	Macedonian and English		
21.	Quality assurance methods	Internal evaluation and student questionnaires		

		Literature				
22.	22.1.	Compulsory				
		No.	Authors	Title	Publisher	Year
		1.	Chaomei Chen	Information Visualization: Beyond the Horizon	Springer, 2 edition	2004
		2.	Gerard Morel	Visualization of Nucleic Acids	CRC, 1 edition	1995
		3.	Thomas Erl	Service-Oriented Architecture: A field guide to integrating XML and web services	Prentice Hall PTR	2004
	22.2.	Additional				
		No.	Authors	Title	Publisher	Year
		1.				
		2.				
		3.				