PRIRODOSLOVNO-MATEMATIČKI FAKULTET U SPLITU

Erasmus catalogue
2024./2025.

	ID	Subject name	Subject name (EN)	Hours (Lectures+Seminars+ Exercises+Fieldwork)	ECTS	Semester	Level	Study
1.	PMT201 251420	3D printanje	3D printing	30+0+30+0	6	5 3 1	Undergraduate Graduate	Computer Science; Mathematics and Computer Science, specialization in Education; Physics (specialization in Education); Physics (specialization in Computational Physics); Physics and Computer Science, specialization in Education; Computer Science and Technics, specialization in Education
2.	PMM602 245248	Algebra I	Algebra I	45+0+0+0	6	1	Graduate	Mathematics (specialization in Pure Mathematics)
3.	PMM606 245252	Algebra II	Algebra II	45+0+0+0	6	2	Graduate	Mathematics (specialization in Pure Mathematics)
4.	PMC101 60919	Analitička kemija I	Analytical chemistry I	30+15+0+0	4	3	Undergraduate	Biology and Chemistry
5.	PMC104 60940	Analitička kemija II	Analytical chemistry II	30+15+0+0	4	4	Undergraduate	Biology and Chemistry
6.	PMC223 240180	Analitičke metode	Analytical methods	30+15+30+0	4	4	Undergraduate	Biology
	PMIK25		Learning Analytics in					Data science and

7.	230831	Analitika učenja	Computer Based Education	30+0+30+0	5	2	Graduate	engineering
8.	267571	Analiza kompleksnih mreža	Complex networks analysis	45+0+0+0	5	2 4	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Statistics and Computer Science)
9.	PMP272 186528	Analiza podataka u fizici visokih energija	Data Analysis in High Energy Physics	30+0+30+0	6	3	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Computational Physics)
10.	PMII15 211924	Arhitekture neuronskih mreža	Neural Network Architectures	30+0+30+0	5	3	Graduate	Computer Science, specialization in Education; Data science and engineering; Mathematics (specialization in Computer Science); Mathematics (specialization in Statistics and Computer Science); Mathematics and Computer Science, specialization in Education

11.	PMP133 267599	Astročestična fizika	Astroparticle Physics	30+0+30+0	6	3	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Computational Physics)
12.	PMP16D 173831	Atmosfersko onečišćenje	Atmospheric pollution	30+0+15+0	4	2	Graduate	Physics (specialization in Biophysics); Physics (specialization in Environmental Physics)
13.	PMP141 267582	Biofizika	Biophysics	45+15+30+0	6	3 1	Graduate	Physics (specialization in Education); Physics (specialization in Biophysics); Physics (specialization in Computational Physics); Physics and Computer Science, specialization in Education
14.	PMP247 267667	Biofizika slušanja i govora	Biophysics of Hearing and Speech	35+5+10+0	5	2	Graduate	Physics (specialization in Biophysics)
								Mathematics and Physics, specialization in Education;

15.	PMP140 267579	Bioinformatika	Bioinformatics	30+0+30+0	5	3 1	Graduate	Physics (specialization in Biophysics); Physics and Computer Science, specialization in Education
16.	PMB513 212276	Biološka oceanografija	Biological oceanography	30+15+0+0	4	4	Undergraduate	Biology
17.	PPB253 173081	Citogenetičke analize kromosoma	Cytogenetic Chromosome Analysis	10+5+15+0	2	5	Undergraduate	Biology; Biology and Chemistry
18.	PMM950 159820	Diferencijalne jednadžbe	Differential equations	30+0+30+0	6	3	Undergraduate	Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics; Physics; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
19.	PMM152 240159	Diferencijalni i integralni račun I	Differential and Integral Calculus I	45+0+60+0	8.5	2	Undergraduate	Mathematics and Physics; Mathematics; Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI); Mathematics and

								Physics (INŽENJERSKI)
20.	PMM156 240160	Diferencijalni i integralni račun II	DIFFERENTIAL AND INTEGRAL CALCULUS II	45+0+60+0	9	3	Undergraduate	Mathematics and Physics (specialization in Education); Mathematics and Physics; Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI)
21.	PMP270 267595	Dinamika atoma u plinovima i tekućinama	Dynamics of Atoms in Gases and Liquids	30+30+0+0	6	3 1	Graduate	Physics (specialization in Biophysics); Physics (specialization in Computational Physics)
22.	PMM810 173195	Diofantske jednadžbe	Diophantine equation	30+15+0+0	5	3 1	Graduate	Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Mathematics and Computer Science, specialization in Education; Mathematics and Physics, specialization in Education
								Physics (specialization in

23.	PMPMSC 68256	Diplomski rad	Diploma Thesis	0+10+0+0	30	4	Graduate	Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics)
24.	PMB506 212263	Ekologija I	Ecology I	30+15+0+0	4	3	Undergraduate	Biology
25.	PPB265 79365	Ekologija podzemnih staništa	Ecology of Subterranean Habitats	15+15+0+0	2	6 2	Undergraduate Graduate	Biology and Chemistry; Biology and Chemistry, specialization in Education
26.	PMP122 267584	Eksperimentalne metode moderne fizike	Experimental Methods of Modern Physics	30+15+15+0	6	1	Graduate	Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Computational Physics); Physics and

									Computer Science, specialization in Education
27.	PMP003 251428	Elektricitet i magnetizam	Electricity and Magnetism	60+15+30+0	9	2 4	Undergraduate	Mathematics and Physics; Physics; Mathematics (specialization in Applied Mathematics); Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
28.	PMP118 201707	Elektrodinamika	Electrodynamics	45+15+30+0	8	5	Undergraduate	Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics; Mathematics (specialization in Applied Mathematics); Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
									Mathematics (staro); Mathematics and Computer Science (staro); Mathematics and Physics

29.	PMM019 111939	Elementarna geometrija	Elementary geometry	30+0+30+0	6	2 4 6	Undergraduate	(specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics; Mathematics; Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI)
30.	PMT168 79744	Energetika	Energetics	30+15+0+0	4	1	Graduate	Computer Science and Technics, specialization in Education
31.	PMT175 87307	Energetika i okoliš	Energy and environment	15+15+0+0	2	3	Graduate	Computer Science and Technics, specialization in Education
32.	PMP108 173241	Filozofija znanosti	Philosophy of Science	15+15+0+0	2	3 5	Undergraduate	Computer Science; Physics
33.	PMM306 67174	Financijska matematika	Financial mathematics	30+0+30+0	5	3 1	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Education); Mathematics (specialization in Statistics and Computer Science); Mathematics and Computer Science, specialization in

								Education; Mathematics and Physics, specialization in Education
34.	PMP201 186404	Fizika čvrstog stanja	Solid State Physics	30+0+30+0	6	1 3	Graduate	Engineering Physics (specialization in Thermodynamic Systems); Engineering Physics (specialization in Mechanical Systems); Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics); Physics and Computer Science, specialization in

								Education
35.	PMP20E 227862	Fizika elementarnih čestica I	Elementary Particle Physics I	45+0+15+0	6	4 2	Graduate	Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Computational Physics)
36.	PMP234 240175	Fizika elementarnih čestica II	Elementary Particle Physics II	45+0+15+0	6	3	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Computational Physics)
37.	PMP163 216059	Fizika mora I	Ocean Physics I	30+0+15+0	5	3 1	Graduate	Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics (specialization in Environmental Physics)

38.	PMP268 240173	Fizika mora II	Ocean Physics II	30+5+15+0	5	4 2	Graduate	Mathematics and Physics, specialization in Education; Physics (specialization in Environmental Physics)
39.	PMB034 133763	Fiziologija bilja	Plant physiology	45+0+45+0	8	5	Undergraduate	Biology; Biology and Chemistry
40.	PMM820 215449	Fourierova analiza i primjene	Fourier Analysis and Applications	30+0+30+0	5	6 4	Undergraduate Graduate	Mathematics (specialization in Applied Mathematics); Mathematics (specialization in Pure Mathematics)
41.	PMB547 212274	Genetika i biotehnologija u agrikulturi	Genetics and Biotechnology in agriculture	30+10+20+0	4	3	Undergraduate	MP; Biology
42.	PMIK80 173003	Informatička praksa	Informatics Practice	0+0+0+176	5	5 6 3 4	Undergraduate Graduate	Computer Science; Computer Science, specialization in Education; Computer Science and Technics, specialization in Education
43.	PMIK80 269041	Informatička praksa	Informatics Practice	0+0+0+176	5	3 4	Graduate	Computer Science, specialization in Education; Computer Science and Technics, specialization in Education
								Biology and

44.	PPC215 201662	Instrumentalne metode analize	Instrumental methods of analysis	15+0+15+0	2	1	Graduate	Chemistry, specialization in Education
45.	PMB731 243646	Instrumentalne metode analize	Instrumental Methods of Chemical Analysis	15+0+15+0	3	3	Graduate	Molecular Biology
46.	PMP134 267598	Istraživački rad	Research Project	0+30+0+0	6	3	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics)
47.	PMP276 99735	Istraživački rad iz računarske fizike I	Research in Computational Physics I	0+20+0+0	5	2	Graduate	Physics (specialization in Computational Physics)
48.	PMP407 186484	Istraživački rad iz biofizike	Research in Biophysics	10+20+0+0	5	3	Graduate	Physics (specialization in Biophysics)
49.	PMP26C 227855	Istraživački rad iz fizike okoliša	Research in Environmental Physics	10+20+30+0	6	3	Graduate	Physics (specialization in Environmental Physics)
50.	PMP277 186530	Istraživački rad iz računarske fizike II	Research in Computational Physics II	5+15+0+0	5	3	Graduate	Physics (specialization in Computational Physics)
51.	PMS173	Izvannastavne i	Extracurricular Activities	15+15+0+0	2	4	Graduate	Biology and Chemistry, specialization in Education; Computer Science, specialization in Education; Mathematics (specialization in Education); Mathematics and

	79233	izvanškolske aktivnosti				2		Physics, specialization in Education; Physics (specialization in Education); Computer Science and Technics, specialization in Education
52.	PPC311 133989	Kemija ugljikohidrata u prehrani	Food Carbohydrate Chemistry	30+0+0+0	2	6	Undergraduate	Biology and Chemistry
53.	PMS135 79108	Kineziološka aktivnost, fitness i zdravlje	Kinesiological activity, fitness and health	15+0+15+0	2	3 1	Graduate	Biology and Chemistry, specialization in Education; Mathematics (specialization in Education); Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Environmental

								Physics); Physics (specialization in Computational Physics)
54.	PMP116 186642	Klasična mehanika	Clasical Mechanics	45+0+45+0	8	3 5	Undergraduate	Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics; Mathematics (specialization in Applied Mathematics); Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
55.	PMP110 251437	Klasična mehanika I	Classical Mechanics I	45+0+30+0	6	3	Undergraduate	Physics
56.	PMP111 251441	Klasična mehanika II	Classical Mechanics II	45+0+30+0	6	4	Undergraduate	Physics
57.	PMP112 251447	Klasični elektromagnetizam	Classical Electromagnetism	45+15+30+0	6	5	Undergraduate	Physics
58.	PMP169 227866	Klimatski sustav	Climate System	35+0+30+0	6	3	Graduate	Physics (specialization in Environmental Physics)
59.	PMS174 159956	Kognitivna psihologija	Cognitive psychology	15+15+15+0	4	4	Graduate	Mathematics (specialization in Education)
								Mathematics (staro);

								Mathematics and Computer Science (staro); Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics; Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics); Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
60.	PMM804 186594	Kombinatorika	Combinatorics	30+0+30+0	5	4 6	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics and Physics (specialization in Education);

61.	PMM116 60987	Kompleksna analiza	Complex analysis	30+0+30+0	6	6 5	Undergraduate	Mathematics and Physics; Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics); Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
62.	PMSN09 134030	Komunikacijske vještine	Communication Skills	15+15+0+0	2	6 4	Undergraduate Graduate	Computer Science; Biology and Chemistry, specialization in Education; Mathematics (specialization in Education); Computer Science and Technics, specialization in Education
63.	PMB517 227846	Kralježnjaci	Vertebrates	30+15+30+0	6.5	5	Undergraduate	Biology; Biology and Chemistry
								Mathematics (specialization in

								Computer Science); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Mathematics (specialization in Statistics and Computer Science); Mathematics and Physics, specialization in Education
64.	PMM205 79334	Kriptografija	Cryptography	30+15+15+0	5	1 3	Graduate	
65.	PMP117 251451	Kvantna fizika	Quantum Physics	40+15+30+0	6	6	Undergraduate	Mathematics and Physics; Physics; Mathematics (specialization in Applied Mathematics); Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
66.	PMP202 251497	Kvantno računanje	Quantum Computing	30+15+15+0	6	3 1	Graduate	Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics (specialization in Computational

								Physics); Physics and Computer Science, specialization in Education
67.	PMM153 240155	Linearna algebra I	Linear Algebra I	45+0+60+0	8.5	1	Undergraduate	Mathematics and Physics; Mathematics; Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
68.	PMM154 240156	Linearna algebra II	Linear algebra II	45+0+60+0	8.5	2	Undergraduate	Mathematics and Physics; Mathematics; Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
69.	PPB266 79366	Makrozoobentos krških tekućica	Macrozoobenthos of the Karst Streams	15+15+0+0	2	5	Undergraduate	Biology; Biology and Chemistry
								Mathematics and Physics (Inženjerski); Mathematics and Physics; Mathematics

70.	PMM157 240189	Matematička analiza u R^n I	Mathematical analysis in R^n I	45+0+45+0	7.5	3	Undergraduate	(specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics); Mathematics and Physics (INŽENJERSKI)
71.	PMM110 67177	Matematička logika	Mathematical Logic	30+0+30+0	5	3	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science)
72.	PMM612 245244	Matematička teorija računarstva	Mathematical theory of Computation	45+0+30+0	6	2 4	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Mathematics (specialization in Statistics and Computer Science)
73.	PMP107 251439	Matematičke metode fizike I	Mathematical methods of physics I	45+15+30+0	6	3	Undergraduate	Physics
	PMP101	Matematičke metode	Mathematical Methods of					

74.	87742	fizike II	Physics II	45+0+30+0	6	4	Undergraduate	Physics
75.	PMP102 79383	Matematičke metode fizike III	Mathematical Methods of Physics III	30+0+30+0	5	5	Undergraduate	Physics
76.	PMM017 240162	Matematički programski alati I	Mathematical program tools I	0+0+30+0	2	5 3	Undergraduate	Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics); Mathematics and Computer Science, specialization in Education
77.	PMM018 147957	Matematički programski alati II	Mathematical program tools II	0+0+30+0	2	2 6	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics and Physics (Inženjerski); Mathematics and Physics; Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics); Mathematics and Computer Science,

								specialization in Education; Mathematics and Physics (INŽENJERSKI)
78.	PMMN01 133974	Matematika	Mathematics	30+0+30+0	5	1	Undergraduate	MP; Biology; Biology and Chemistry
79.	PMM005 60463	Matematika I	MATHEMATICS I	45+0+45+0	8	1	Undergraduate	Physics
80.	267456	Matematika I	Mathematics I	30+0+30+0	7	1	Undergraduate	Computer Science; Computer Science and Technics
81.	PMT154 79737	Materijali	Materials	45+0+15+0	5	3	Undergraduate	Computer Science and Technics
82.	267668	Medicinska fizika	Medical Physics	45+5+10+0	6	2	Graduate	Physics (specialization in Biophysics)
83.	PMP001 251426	Mehanika	Mechanics	60+15+30+0	9	1 3	Undergraduate	Mathematics and Physics; Physics; Mathematics (specialization in Applied Mathematics); Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
84.	PMP161	Meteorologija I	Meteorology I	30+5+15+0	5	3	Graduate	Mathematics and Physics, specialization in Education; Physics (specialization in

	240172					1		Education); Physics (specialization in Environmental Physics)
85.	PMP260 216065	Meteorologija II	Meteorology II	30+0+15+0	5	2	Graduate	Physics (specialization in Environmental Physics)
86.	PMC210 79847	Metodika nastave kemije I	Chemistry Education I	30+30+0+0	4	2	Graduate	Biology and Chemistry, specialization in Education
87.	PMM133 97073	Metodika nastave primijenjene matematike	Methods of Instructions in Applied Mathematics	30+0+30+0	5	2 4	Graduate	Mathematics (specialization in Education); Mathematics and Computer Science, specialization in Education; Mathematics and Physics, specialization in Education
88.	PMP104 99958	Metodologija istraživanja u prirodnim znanostima	Research Methodology in Natural Sciences	30+0+15+0	4	2	Graduate	Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in

								Environmental Physics); Physics (specialization in Computational Physics)
89.	PMM601 245249	Metrički prostori	Metric spaces	45+0+0+0	6	1	Graduate	Mathematics (specialization in Pure Mathematics)
90.	PMP26E 227849	Modeliranje elektromagnetskih pojava u okolišu	Modelling Electromagnetic Phenomena in the Environment	30+20+10+0	6	3	Graduate	Physics (specialization in Environmental Physics)
91.	PMP26D 227852	Modeliranje fluida u okolišu	Environmental Fluid Dynamics	30+20+10+0	6	3	Graduate	Physics (specialization in Environmental Physics)
92.	PMII80 79281	Modeliranje i simulacija	Modelling and Simulation	30+0+30+0	6	3	Undergraduate	Computer Science
93.	PMP249 227869	Modeliranje i simulacije biomakromolekula	Modelling and Simulations of Biomacromolecule	30+0+30+0	5	3	Graduate	Physics (specialization in Biophysics)
94.	PMP008 251444	Moderna fizika	Modern Physics	45+15+30+0	6	4	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
95.	PMB545 212278	Molekularna genetika	Molecular Genetics	30+15+0+0	3.5	4	Undergraduate	Biology
96.	PMP230	Napredna astronomija i	Advanced Astronomy and	30+15+30+0	6	2	Graduate	Physics (specialization in Astrophysics and

	267596	astrofizika	Astrophysics					Elementary Particle Physics)
97.	PMP113 251450	Napredna elektrodinamika	Advanced Electrodynamics	45+15+30+0	6	6	Undergraduate	Physics
98.	PMP200 251483	Napredna kvantna fizika	Advanced Quantum Physics	30+15+30+0	6	1	Graduate	Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics); Physics and Computer Science, specialization in Education
99.	PMP115 267519	Napredna statistička fizika	Advanced Statistical Physics	45+15+15+0	6	6	Undergraduate	Physics
100.	PMM605 245253	Normirani prostori	Normed spaces	45+0+0+0	6	2	Graduate	Mathematics (specialization in Pure Mathematics)

101.	PMP203 267577	Nuklearna fizika	Nuclear Physics	30+0+30+0	6	2 4	Graduate	Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics); Physics and Computer Science, specialization in Education
102.	PMM118 79583	Numerička analiza	Numerical analysis	30+0+30+0	5	4 2	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Statistics and Computer Science)
								Mathematics

103.	PMM210 68172	Numerička linearna algebra	Numerical linear algebra	30+0+30+0	5	2	Graduate	(specialization in Computer Science); Mathematics (specialization in Statistics and Computer Science)
104.	PMM103 60972	Obične diferencijalne jednadžbe	Ordinary differential equations	30+0+30+0	6	5 3	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics)
105.	PMT179 87409	Obnovljivi izvori energije	Renewable Energy Sources	15+15+0+0	2	2 4	Graduate	Engineering Physics (specialization in Thermodynamic Systems); Engineering Physics (specialization in Mechanical Systems); Physics (specialization in Education); Physics (specialization in Computational Physics); Computer Science and Technics, specialization in Education
								Computer Science,

106.	PMII45 211929	Obrada prirodnog jezika	Natural language processing	30+0+30+0	5	3	Graduate	specialization in Education; Data science and engineering; Mathematics (specialization in Computer Science)
107.	PMP125 173823	Obrada signala u prirodnim znanostima	Signal Processing in Natural Sciences	30+0+30+0	5	3 1	Graduate	Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics)
108.	PPC207 173100	Odabrana poglavlja iz biokemije	Selected Topics in Biochemistry	15+15+0+0	2	6	Undergraduate	Biology and Chemistry
109.	PMIC61 251416	Okviri i alati za razvoj web aplikacija	Full Stack Development	30+15+0+0	5	5 3	Undergraduate Graduate	Computer Science; Mathematics and Computer Science, specialization in Education
110.	PMP410 267597	Opažačka astronomija	Observational Astronomy	30+15+15+0	6	2	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics)
111.	PMP090 60384	Opća fizika	General Physics	30+0+15+0	4	6 2	Undergraduate Graduate	Mathematics (staro); Biology; Biology and Chemistry; Mathematics (specialization in Mathematics);

						4		Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics)
112.	PMP400 227844	Opća teorija relativnosti i kozmologija	General Relativity and Cosmology	30+0+30+0	6	3	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics)
113.	PMB013 133973	Opća zoologija	General Zoology	30+0+45+0	6	1	Undergraduate	Biology; Biology and Chemistry
114.	PMID70 79328	Operacijski sustavi	Operating Systems	30+0+30+0	5	6 2	Undergraduate Graduate	Computer Science; Computer Science and Technics; Physics; Physics (specialization in Computational Physics)
115.	PMM922 173192	Optimizacija	Optimization	30+15+0+0	5	3 1	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Mathematics (specialization in Statistics and Computer Science)
								Physics; Mathematics and

116.	PMP130 251448	Osnove astronomije i astrofizike	Fundamentals of Astronomy and Astrophysics	30+15+0+0	3	6 3 4 2	Undergraduate Graduate	Physics, specialization in Education; Physics (specialization in Education); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics); Physics and Computer Science, specialization in Education
117.	PMM812 267570	Osnove geometrije	Foundations of geometry	45+0+0+0	6	1 3	Graduate	Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Mathematics and Computer Science, specialization in Education; Mathematics and Physics, specialization in Education
118.	PPB259 79354	Osnove histoloških tehnika	Basic histological techniques	15+0+15+0	2	5	Undergraduate	Biology and Chemistry
								Mathematics and Physics (specialization in

								Education); Mathematics and Physics (Inženjerski); Mathematics (specialization in Mathematics); Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI); Mathematics (specialization in Education)
119.	PMM715 201629	Osnovne algebarske strukture	Basic algebraic structures	30+0+30+0	6	6 2 4	Undergraduate Graduate	
120.	PMM915 160133	Parcijalne diferencijalne jednadžbe	Partial Differential Equations	30+0+30+0	6	6 2 4	Undergraduate Graduate	Physics; Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Environmental Physics); Physics (specialization in Computational

								Physics)
121.	PMS172 79115	Pedagogija slobodnog vremena	Pedagogy of spare time	15+15+0+0	2	3 1	Graduate	Biology and Chemistry, specialization in Education; Mathematics (specialization in Education); Mathematics and Physics, specialization in Education; Physics (specialization in Education)
122.	PMP26H 251502	Podaci u oceanografiji: izvori, korištenje i upravljanje	Short Course on Marine Data Literacy	20+0+24+0	3	1 3	Graduate	Physics (specialization in Environmental Physics)
123.	PMS140 173690	Poučavanje učenika s posebnim potrebama	Teaching students with special needs	15+15+0+0	2	4 2	Graduate	Biology and Chemistry, specialization in Education; Computer Science, specialization in Education; Mathematics (specialization in Education); Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics and Computer Science,

								specialization in Education; Computer Science and Technics, specialization in Education
124.	PMP009 68195	Povijest klasične fizike	History of Classical Physics	30+0+0+0	3	3 1	Graduate	Mathematics (specialization in Pure Mathematics); Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics); Physics and Computer Science, specialization in Education
								Engineering Physics

								(specialization in Thermodynamic Systems); Engineering Physics (specialization in Mechanical Systems); Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics); Physics and Computer Science, specialization in Education
125.	PMP103 68220	Povijest moderne fizike	History of Modern Physics	30+0+0+0	3	2 4	Graduate	
126.	PMC102 60920	Praktikum iz analitičke kemije I	Laboratory course in analytical chemistry I	0+0+45+0	3	3	Undergraduate	Biology and Chemistry
127.	PMC105 60941	Praktikum iz analitičke kemije II	Laboratory Course in Analytical Chemistry II	0+0+45+0	3	4	Undergraduate	Biology and Chemistry
								Physics

128.	PMP142 251486	Praktikum iz biofizike	Laboratory in Biophysics	10+0+40+0	4	2	Graduate	(specialization in Biophysics)
129.	PMP012 251446	Praktikum iz elektriciteta i magnetizma	Laboratory in Electricity and Magnetism	0+0+40+0	3	4	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
130.	PMP011 251438	Praktikum iz mehanike	Laboratory in Mechanics	0+0+40+0	3	3	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
131.	PMP20F 186482	Praktikum iz moderne fizike	Laboratory in Modern Physics	0+0+40+0	3	1	Graduate	Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Computational Physics); Physics and Computer Science, specialization in Education

132.	PPB282 79353	Praktikum iz molekularne genetike	Practical Skills in Molecular Genetics	0+0+30+0	2	6 2	Undergraduate Graduate	Biology and Chemistry; Biology and Chemistry, specialization in Education
133.	PMC007 60944	Praktikum iz organske kemije	Laboratory Course in Organic Chemistry	0+0+60+0	4.5	4	Undergraduate	Biology and Chemistry
134.	PMP014 251452	Praktikum iz termodinamike i moderne fizike	Laboratory in Thermodynamics and Modern Physics	0+0+40+0	3	6	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
135.	PMP013 251449	Praktikum iz valova i optike	Laboratory in Waves and Optics	0+0+40+0	3	5	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
136.	PMIG10 87288	Primijenjena statistika	Applied Statistics	30+0+30+0	6	4	Undergraduate	Computer Science
137.	PMP074 251427	Primjena programiranja u fizici	Application of Programming in Physics	30+0+30+0	5	2	Undergraduate	Physics
138.	PMP162 61264	Prirodne znanosti i okoliš	Natural Science and the Environment	30+0+10+0	4	3 5	Undergraduate	Mathematics (staro); Physics; Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science)

139.	PPC210 79371	Prirodni toksini u moru	Natural toxins in the sea	15+0+0+0	2	4 6	Undergraduate	Biology; Biology and Chemistry
140.	PMIC60 79327	Programiranje mrežnih aplikacija	Network Application Programming	30+0+30+0	5	6 4 2	Undergraduate Graduate	Mathematics and Computer Science (staro); Computer Science; Computer Science and Technics; Physics; Mathematics (specialization in Computer Science); Physics (specialization in Computational Physics)
141.	PMM501 251510	Prostorna statistika s primjenama	Applied spatial statistics	30+0+30+0	5	4	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Statistics and Computer Science)
142.	PMP200 232273	Quantum Physics II	Quantum Physics II	30+0+30+0	6	1	Graduate	Physics (Physics, specialization in Astrophysics and Elementary Particle Physics); Physics (Physics, specialization in Environmental Physics)
								Computer Science;

143.	PMII60 147925	Računalni vid	Computer vision	30+0+30+0	5	6 2 4	Undergraduate Graduate	Computer Science, specialization in Education; Mathematics (specialization in Computer Science); Mathematics and Computer Science, specialization in Education; Physics and Computer Science, specialization in Education; Computer Science and Technics, specialization in Education
144.	PMP170 207235	Računarska fizika	Computational Physics	20+5+20+0	4	6	Undergraduate	Physics
145.	PMIC50 148038	Raspodijeljeni sustavi	Distributed systems	30+0+30+0	5	2 4	Graduate	Computer Science, specialization in Education; Mathematics (specialization in Computer Science); Mathematics and Computer Science, specialization in Education; Physics and Computer Science, specialization in Education; Computer Science and Technics, specialization in Education

146.	PPC221 201658	Razvoj i optimizacija analitičkih metoda	Development and optimization analytical chemical methods	0+0+30+0	2	5 1	Undergraduate Graduate	Biology and Chemistry; Biology and Chemistry, specialization in Education
147.	PMP134 245480	Research Project	Research Project	0+30+0+0	5	3	Graduate	Physics (Physics, specialization in Astrophysics and Elementary Particle Physics)
148.	PMP274 251500	Simetrije u fizici	Symmetries in Physics	30+0+30+0	6	1	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Computational Physics)
149.	PMM920 160164	Složenost algoritama	Complexity of algorithms	30+0+30+0	6	3	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Statistics and Computer Science)
								Biology and Chemistry, specialization in Education; Computer Science, specialization in Education; Mathematics (specialization in Education);

150.	PMS108 133963	Sociologija odgoja i obrazovanja	Sociology of Education	15+15+0+0	2	3 1	Graduate	Mathematics and Computer Science, specialization in Education; Mathematics and Physics, specialization in Education; Physics (specialization in Education); Computer Science and Technics, specialization in Education
151.	PMS111 60523	Sociologija znanosti	Sociology of science	15+15+0+0	2	3 5	Undergraduate	Mathematics (staro); Computer Science; Physics; Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science)
152.	PMP401 232280	Special Relativity	Special Relativity	30+0+15+0	4	1	Graduate	Physics (Physics, specialization in Astrophysics and Elementary Particle Physics)
153.	PMP114 267518	Statistička fizika	Statistical Physics	45+0+30+0	6	5 1	Undergraduate Graduate	Physics; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI); Physics and

								Computer Science, specialization in Education
154.	PMM861 201568	Statistika	STATISTICS	30+0+15+0	4	2	Undergraduate	Biology
155.	PMM911 160162	Statistika u računarstvu	STATISTICS IN COMPUTER SCIENCE	30+0+30+0	5	1	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Statistics and Computer Science)
156.	PMP271 148176	Stohastičke simulacije u klasičnoj i kvantnoj fizici	Stochastic Simulations in Classical and Quantum Physics	30+0+30+0	6	2	Graduate	Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics)
157.	PMS252 173165	Strani jezik u struci I (Engleski)	English for Specific Purposes I	0+30+0+0	2	1	Undergraduate	MP; Biology; Biology and Chemistry
158.	PMS253	Strani jezik u struci II	English for Specific Purposes	0+30+0+0	2	2	Undergraduate	Biology; Biology and

	173171	(Engleski)	(II)					Chemistry
159.	PMP26G 251488	Svjetlost i fotosinteza u moru	Light and Photosynthesis in the Sea	30+20+0+0	4	1	Graduate	Physics (specialization in Biophysics); Physics (specialization in Environmental Physics)
160.	PMP071 159411	Tekstualni i grafički programi za fizičare	Text and Graphical Programs for Physicists	0+0+30+0	1	1	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
161.	PMM614 245245	Teorija dizajna	Design Theory	45+0+0+0	5	2 4	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Mathematics (specialization in Statistics and Computer Science); Mathematics and Computer Science, specialization in Education
								Mathematics (staro); Mathematics and Computer Science (staro);

162.	PMM806 201744	Teorija grafova	Graph theory	30+0+30+0	5	6 2 4	Undergraduate Graduate	Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics); Mathematics (specialization in Statistics and Computer Science); Mathematics and Computer Science, specialization in Education
163.	267572	Teorija igara	Game Theory	45+0+0+0	5	3 1	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Education); Mathematics (specialization in Statistics and Computer Science); Mathematics and Computer Science, specialization in Education; Mathematics and Physics, specialization in Education
								Mathematics and Physics,

								specialization in Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Computational Physics); Physics and Computer Science, specialization in Education
164.	PMP401 267581	Teorija relativnosti	Relativity	30+0+30+0	6	3 1	Graduate	
165.	PMM112 79236	Teorija skupova	Set theory	30+0+30+0	6	4	Undergraduate Graduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics); Mathematics and Physics, specialization in Education
166.	PMB014 69126	Terenska nastava iz opće zoologije	Field Training in General Zoology	15+0+0+0	0.5	1	Undergraduate	Biology; Biology and

								Chemistry
167.	PMP007 251443	Termodinamika	Thermodynamics	60+15+30+0	9	4	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
168.	PMP20C 251496	Termodinamika nepovratnih procesa	Irreversible Process Thermodynamics	45+0+15+0	6	3	Graduate	Mathematics and Physics, specialization in Education; Physics (specialization in Biophysics); Physics (specialization in Computational Physics)
169.	PMS131 79338	Tjelesna i zdravstvena kultura I	Physical Education I	0+0+30+0	0.5	3 5 1	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Biology
170.	PMS132 79339	Tjelesna i zdravstvena kultura II	Physical Education II	0+0+30+0	0.5	4 2	Undergraduate	Mathematics (staro); Biology
171.	PMB735 254797	Toxicology	Toxicology	30+0+0+0	3	5 1 3	Undergraduate Graduate	Biology and Chemistry; Biology and Chemistry, specialization in Education; Molecular Biology
								Computer Science; Computer Science,

172.	PMII70 147945	Trodimenzionalno projektiranje fizičkih objekata	Three-dimensional design of physical objects	30+0+30+0	5	6 4 2	Undergraduate Graduate	specialization in Education; Physics and Computer Science, specialization in Education; Computer Science and Technics, specialization in Education
173.	PMS160 79109	Upravljanje razredom	Classroom management	15+15+0+0	2	3 1	Graduate	Biology and Chemistry, specialization in Education; Computer Science, specialization in Education; Mathematics (specialization in Education); Mathematics and Physics, specialization in Education; Physics (specialization in Education); Physics and Computer Science, specialization in Education; Computer Science and Technics, specialization in Education
								Mathematics and Physics, specialization in

								Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics)
174.	PMP204 97418	Uvod u atomsku i molekularnu fiziku	Introduction to Atomic and Molecular Physics	30+30+0+0	6	4 2	Graduate	
175.	PMM120 68173	Uvod u diferencijalnu geometriju	Introduction to differential geometry	30+0+30+0	6	6 2 4	Undergraduate Graduate	Physics; Mathematics (specialization in Applied Mathematics); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Mathematics and Physics, specialization in Education; Physics (specialization in Computational

								Physics)
176.	PMM505 215364	Uvod u financijsku matematiku	Introduction to financial mathematics	30+0+30+0	5	4	Undergraduate Graduate	Mathematics (staro); Mathematics (specialization in Mathematics); Mathematics and Computer Science, specialization in Education
177.	PMP096 79401	Uvod u fiziku	Introduction to Physics	45+0+15+0	4	2	Undergraduate	Computer Science and Technics
178.	PMP160 67165	Uvod u geofiziku	Introduction to Geophysics	30+0+15+0	4	6 4	Undergraduate Graduate	Physics; Mathematics and Physics, specialization in Education; Physics and Computer Science, specialization in Education
179.	PMM151 240185	Uvod u matematičku analizu	Introduction to mathematical analysis	45+0+60+0	8.5	1	Undergraduate	Mathematics and Physics; Mathematics; Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
								Mathematics and Physics (specialization in Education); Mathematics and

180.	PMM700 201624	Uvod u matematičku logiku i teoriju skupova	Introduction to Mathematical Logic and Set Theory	30+0+30+0	5	5 3	Undergraduate	Physics (Inženjerski); Mathematics and Physics; Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
181.	PMP261 216053	Uvod u mehaniku fluida	Introduction to Fluid Mechanics	30+0+30+0	6	3 1	Graduate	Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics)
182.	PMM108 60990	Uvod u numeričku matematiku	Introduction to Numerical Mathematics	30+0+30+0	5	3 5	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics)
								Physics

183.	PMP165 216064	Uvod u obradu podataka	Introduction to Data Analysis	20+0+30+0	5	2	Graduate	(specialization in Environmental Physics)
184.	PMM701 215311	Uvod u primijenjenu matematiku	Introduction to Applied Mathematics	30+0+30+0	5	4	Undergraduate	Mathematics and Computer Science, specialization in Education
185.	PMM102 148613	Uvod u teoriju brojeva	Introduction to Number Theory	30+0+30+0	5	4	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics and Physics (specialization in Education); Mathematics and Physics; Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics and Computer Science, specialization in Education; Mathematics and Physics (NASTAVNIČKI)
186.	PMM114 67191	Uvod u topologiju	Introduction to topology	30+0+30+0	6	6	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics (specialization in Mathematics); Mathematics

								(specialization in Computer Science); Mathematics (specialization in Applied Mathematics)
187.	PMII10 79324	Uvod u umjetnu inteligenciju	Introduction to Artificial Intelligence	30+0+30+0	5	5 3 1	Undergraduate Graduate	Mathematics (staro); Mathematics and Computer Science (staro); Computer Science; Physics; Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Physics and Computer Science, specialization in Education; Computer Science and Technics, specialization in Education
								Mathematics (staro); Mathematics and

								Computer Science (staro);
188.	PMM716 201635	Uvod u vjerojatnost	INTRODUCTION OF PROBABILITY	45+0+45+0	8	6 2	Undergraduate Graduate	Mathematics and Physics; Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics); Mathematics and Computer Science, specialization in Education; Mathematics and Physics (INŽENJERSKI); Mathematics and Physics, specialization in Education
189.	PMP006 251436	Valovi i optika	Waves and Optics	60+15+30+0	9	3 5	Undergraduate	Mathematics and Physics; Physics; Mathematics (specialization in Applied Mathematics); Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)
								Mathematics (staro);

190.	PMM201 79128	Vektorski prostori I	Vector spaces I	30+0+30+0	6	5 6 2 4	Undergraduate Graduate	Mathematics and Computer Science (staro); Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics); Mathematics (specialization in Education); Mathematics and Computer Science, specialization in Education; Mathematics and Physics, specialization in Education
191.	PMM603 245250	Vektorski prostori II	Vector spaces II	45+0+0+0	6	1	Graduate	Mathematics (specialization in Pure Mathematics)
192.	PMM228 148588	Vjerojatnost I	Probability I	30+0+30+0	6	2 4	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Statistics and Computer Science)

193.	PMM809 173379	Vrednovanje u nastavi	ASSESSMENT IN EDUCATION	0+30+0+0	3	6 4	Undergraduate Graduate	Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Education); Mathematics and Physics, specialization in Education
194.	PMPBSC 251453	Završni rad	Undergraduate Thesis	0+15+0+0	5	6	Undergraduate	Physics
195.	PMPBSC 251507	Završni rad	Undergraduate Thesis	0+15+0+0	3	6	Undergraduate	Mathematics and Physics; Mathematics and Physics (NASTAVNIČKI); Mathematics and Physics (INŽENJERSKI)

Subject name	3D printing						
ID	PMT201	Study year	2.				
Lecturer	doc. dr. sc. Ivan Peko	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	0	30	0	
Subject status	Elective	Online percentage	0%				
Subject description							
Subject goals	– To be informed about different processes and technologies of 3D printing and the possibilities of their application in different branches of industry, medicine, dentistry, bioengineering, biotechnology, nanotechnology... – Develop skills for 3D design and creation of designed models on devices and machines for 3D printing – Acquire skills about all stages of the 3D printing process and producing a functional product – To be informed about the possibilities of connecting 3D printing and 3D scanning and other 3D technologies with the aim of applying them in different fields: in industry, medicine, dentistry, bioengineering, biotechnology...						
Enrolment requirements	None.						
Learning outcomes	Learning outcomes expected at the level of the course (4 to 10 learning outcomes) – Describe different 3D printing procedures and processes – Choose the appropriate 3D printing technology depending on specific requirements and applications – Choose a suitable material for making the desired product using the 3D printing process – Define suitable parameters on the machine/device for 3D printing with the aim of obtaining a quality printed product – Plan the 3D printing process from the initial design to the final product – Connect 3D scanning with 3D printing – Design own product in 3D design software and produce it on a 3D printer						
Syllabus	Lectures: 1. Introduction to 3D printing, historical development of the technology 2. Application of 3D printing 3. Phases and flow of the 3D printing process 4. 3D printing processes: production from liquid materials 5. 3D printing processes: production from powder materials 6. 3D printing processes: production from solid materials 7. Machines and devices for 3D printing, 3D printing parameters settings 8. Materials for 3D printing 9. Design for 3D printing 10. 3D printing in industry 11. 3D / 4D printing in medicine, dentistry 12. 3D / 4D printing in bioengineering and biotechnology						

<table>
<tr><td></td><td colspan="6">13. 3D printing in nanotechnology
14. Future perspectives and trends in the development of 3D printing
15. 3D scanning, connecting 3D scanning and 3D printing, reversible engineering

Exercises:
Week 1 – Week 7: 3D design on the computer
Week 8 – Week 10: 3D design of own product on the computer
Week 11 – Week 13: 3D printing of designed products
Week 14: 3D scanning. Connection between 3D scanning and 3D printing.
Reversible engineering.</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☑ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☑ Multimedia
☑ Laboratory
☐ Mentoring</td><td>☑
Radionice
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Active participation in lectures and constructive/practical exercises.</td></tr>
<tr><td>Monitoring student work</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical work</td><td>1</td></tr>
<tr><td></td><td>Experimental work</td><td>1</td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Colloquiums</td><td>1</td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Written exam</td><td>1</td><td>Project</td><td>1</td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">2 tests (midterm exams)/final exam from the theoretical part
Grade = (K1 + K2)/2
(K1: result of the 1st test, K2: result of the 2nd test)
Rating by percentages: 50 – 62%: sufficient (2), 63 – 75%: good (3), 76 – 87%: very good (4), 88 – 100%: excellent (5)</td></tr>
<tr><td>Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td></td><td colspan="4">Andreas Gebhardt, Jan-Steffen Hötter: Additive Manufacturing – 3D Printing for Prototyping and Manufacturing, Hanser Publications, Cincinnati, 2016.</td><td></td><td></td></tr>
<tr><td></td><td colspan="4">Ben Redwood, Filemon Schöffer, Brian Garret: The 3D Printing Handbook –Technologies, design and applications, 3D Hubs, Amsterdam, 2017.</td><td></td><td></td></tr>
<tr><td></td><td colspan="4">Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani: Additive</td><td></td><td></td></tr>
</table>

	ManufacturingTechnologies, Springer, 2021.		
	Mohammed Maniruzzaman: 3D and 4D Printing in Biomedical Applications, Wiley-VCH, 2019.		
	Georgios Tsoulfas, Petros I. Bangeas, Jasjit S. Suri: 3D Printing: Applications in Medicine and Surgery, Elsevier, 2020.		
	Deepak M. Kalaskar: 3D Printing in Medicine, Elsevier, 2017.		
	Sanjay ¬Kumar: Additive Manufacturing Processes, Springer, 2020.		
	John O. Milewski: Additive Manufacturing of Metals - From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewelry, Springer, 2017.		
	Ehsan Toyserkani, Dyuti Sarker, Osezua Obehi Ibhadode, Farzad Liravi, Paola Russo, Katayoon Taherkhani: Metal Additive Manufacturing, Wiley, 2022.		
Supplementary literature	Richard Leach, Simone Carmignato: Precision Metal Additive Manufacturing, CRC Press, 2021.		
Quality assurance	Conversation with students, student evaluation using an anonymous survey, student success in the exam, self-assessment.		
Other (in the opinion of the proponent)			

Subject name	Algebra I					
ID	PMM602	Study year	1.			
Lecturer	doc. dr. sc. Gordan Radobolja	Points value (ECTS)	6.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			45	0	0	0
Subject status	Compulsory	Online percentage	30%			
Subject description						
Subject goals	This course is the first part of a standard graduate algebra course which considers group and ring theory. In particular, the emphasis is on free groups, finitely generated abelian groups, their subgroups, certain classes of commutative rings with identity and certain classes of ideals. The gained knowledge should serve as a basis for the second part of the course and for continuation of studies on the postgraduate level.					
Enrolment requirements	Successful completion of undergraduate courses which consider algebraic structures; in internal case: Vector spaces I and Algebraic structures.					
Learning outcomes	Upon successful completion of the course student should understand fundamental concepts of group and ring theory; demonstrate familiarity with terminology of category theory; distinguish the complexity of group structure problem in abelian and nonabelian case; be able to give presentations of groups; be capable of describing a structure of finitely generated abelian group; distinguish certain classes of commutative rings by their specific division (factorization) properties; show capacity for mathematical reasoning through analysing, proving and explaining major results; demonstrate accurate and efficient use of advanced algebraic techniques.					
Syllabus	Groups, categories, direct products and direct sums, internal products and sum. Product of a family of homomorphisms. (6 hours) Free groups, free products, free abelian groups and their subgroups. Structure theory of finitely generated abelian groups. (6 hours)					

	The action of a group on a set. (2 hours) The Sylow theorems. (2 hours) Nilpotent and solvable groups. (2 hours) Rings and homomorphisms of rings, ideals (prime and maximal ideals), direct product of rings. Chinese remainder theorem. (6 hours) Factorization in rings, prime and irreducible elements. (2 hours) Principal ideal domains, Euclidean and unique factorization domains. (2 hours) Rings of fractions. Local rings (2 hours)
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Attending classes, giving report(s) on the research done in order to solve the appointed project problem and taking oral exam.

Monitoring student work						
	Class attendance	1.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	3.5		
	Colloquiums		Oral exam	1		
	Written exam		Project			

Assessment and evaluation of student work	Attending classes, giving report(s) on the research done in order to solve the appointed project problem and taking oral exam.

Required literature	Title	Number of copies available	Availability on other medium
	T. W. Hungerford, Algebra, Springer, New York, 1996.		Pdf file on the Moodle

			platform
Supplementary literature	D. S. Dummit, R.M. Foote, Abstract Algebra, J. Wiley and Sons, Inc., 2004. S. Lang, Algebra, Addison-Wesley Publishing Company, Redwood City, California, 1984.		
Quality assurance	Exam results statistics. Students' quality assessment at the end of the semester carried out by the University authorized committee through anonymous polls.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Algebra II</td></tr>
<tr><td>ID</td><td>PMM606</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Gordan Radobolja</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">State the most important results on polynomials and polynomial rings with the emphasis on polynomials over a field.

Set the theory of algebraic field extensions and prove the fundamental theorem of algebra.

Prove the fundamental theorem of Galois theory and as a consequence, unsolvability of the quintic.

Set the fundations of theory of modules over arbitrary ring.

Prepare the students for more advanced algebraic courses on graduate and postgraduate level.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Courses passed: Algebraic structures and Vector spaces I,

Courses taken: Algebra I.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students will be able to:

interpret formal polynomials in terms of categories

distinguish a formal polynomial and a poynomial function

compare free modules over arbitrary rings and vector spaces

connect algebraic field extensions with group theory

argue on unsolvability of classical Greek problems in terms of field extensions

conclude weather a given algebraic equation is solvable using Galois theory</td></tr>
<tr><td>Syllabus</td><td colspan="6">Ring of quotients (2)

Algebras (2)</td></tr>
</table>

	Polynomial rings (3) Roots of polynomials (1) Factorization in polynomial rings (3) Modules and homomorphisms (4) Sums, products and exact sequences of modules (3) Hom functor (2) Free modules (3) Tensor product of modules (4) Algebraic field extensions (3) Classical Greek problems (1) Splitting fields and algebraic closures (4) Galois theory (4) Applications of Galois theory (3) Abel's theorem (3)

Teaching types	☑ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐

Student obligations	Lectures and exercises attendances are obligatory. Students should write and present seminars.

Monitoring student work	Class attendance	2	Research		Practical work	
	Experimental work		Paper			

	Essay		Seminar paper	1		
	Colloquiums	1	Oral exam	2		
	Written exam		Project			

Assessment and evaluation of student work	Students present one seminar and write two tests. These are prerequisites for oral exam. Final grade is based on seminar (20%), tests (30%) and oral exam (50%).		
Required literature	Title	Number of copies available	Availability on other medium
	T. W. Hungerford, Algebra, Springer, 2003		
	D. S. Dummit, R. M. Foote, Abstract algebra, Wiley, 2003		
Supplementary literature	S. Lang, Algebra, Springer 3rd edition, 2005		
Quality assurance	Discussion in classes and official student survey.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="3">Analytical chemistry I</td></tr>
<tr><td>ID</td><td>PMC101</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivana Mitar</td><td>Points value (ECTS)</td><td>4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L | S | E | P</td></tr>
<tr><td>30 | 15 | 0 | 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>10%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Understanding of basic principles of analytical chemistry and chemical equilibria; dissimilitude different classical methods of qualitative and quantitative analysis.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Completed course General Chemistry I and II.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">The student will be qualified to:
1.apply the fundamental principles and steps of analytical procedures and applications to various areas of science,
2.define the basic concepts of analytical chemistry and quantitative and qualitative analysis,
3.understand and distinguish between acid-base, complex, precipitation, and redox equilibria and all influences on these equilibria,
4.calculate, explan, and interpret analytical results.</td></tr>
<tr><td>Syllabus</td><td colspan="3">LECTURES:

1.Definition, meaning and classification of analytical chemistry
Significance and development of analytical chemistry
Analytical process (problem definition, sampling, selection of analytical methods, analytical signal, report)
Processing of analytical data (range, mean, median, standard deviation).
2.Basic parameters of analytical process quality
Sensitivity, precision, accuracy, robustness, LDP, LOQ, LOD, selectivity
3.Errors in analysis
Types of errors and corrections in the analytical process
Safety of laboratory work.
4.Classification of analytical chemistry
Chemical analysis (qualitative and quantitative)
Variety of physico-chemical and instrumental methods of analysis
5.Chemical equilibrium
Equilibrium constants: thermodynamic, concentration, and conditional Heterogeneous and homogeneous systems
Quantification of chemical equilibria
5.Ionic strength of solutions
Activity and activity coefficient</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">6.Acid-base equilibria
Acid and base strength (α-value); autoprotolysis of water
7.Acid-base buffers
Buffer preparation; buffer capacity.
8.Salt hydrolysis
Acidity and basicity of salts; hydrolysis constant
9.Equilibria of complex formation
Formation constants and cumulative formation constants; ligands, coordination number metal; α-values in complex equilibria
10.Conditional constant of complex stability
Influence of ionic strength and parallel reactions on the formation of complexes
11.Equilibrium between a solid, poorly soluble substance and its ions
Precipitation and dissolution reactions (solubility, solubility product constant)
12.Conditional constant of product solubility
Influence of ionic strength, common and foreign ions, and parallel reactions on solubility product constant
13.Separation of ions by control of precipitating agent
Calculation of feasibility of separations
14.Oxidation-reduction equilibria
Standard electrode potential; electrode potential; Nernst equation.
15.Equilibrium constants of oxidation-reduction reactions
Conditional constant of redox reactions; conditional standard electrode potential

SEMINARS:
Solving numerical examples related to the theoretical material covered.</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Students are required to attend classes (lectures and seminars 80 %) and actively participate in the teaching process. That will be recorded and evaluated in making a final assessment.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical work</td><td>1</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>2</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>1.5</td><td>Project</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">The final grade for the course will consist of a written (seminar) and an oral part (lecture). The written part may be taken in whole or in part by partial examinations during the semester. The exams will be graded as follows:
more than 60 % – adequate,
more than 70 % – good,
more than 80 % – very good and
more than 90 % – excellent.
The oral part of the examination is taken by the students after successfully passing the written examination (partially or completely).</td></tr>
<tr><td rowspan="2">Required literature</td><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td>D. A. Skoog, D. M. West, F. J. Holler, Osnove analitičke kemije, Školska knjiga, Zagreb, 1999.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">1.D. A. Skoog, D. M. West, F. J. Holler and S. R. Crouch, Fundamentals of Analytical Chemistry, 9th Edition, Thompson Brooks/Cole, Belmont, USA, 2014.
2.R. Kellner, J. M. Mermet, M. Otto, M. Valcarcel and H. M. Widmer, Analytical Chemistry (A Modern Approach to Analytical Science, Second Edition), Wiley-VCH, Verlag Gmbh & Co. KGaA, Weinheim, 2004.
3.D. C. Harris, Quantitative Chemical Analysis, W. H. Freeman and Company, 41 Madison Avenue New York, NY, 2016.
4.B. M. Tissue, Basic of Analytical Chemistry and Chemical Equilibria, John Wiley & Sons, Inc., Hoboken, New Jersey, NY, 2013.
5.G. D. Christian, P. K. Dasgupta, K. A. Schug, Analytical Chemistry, John Wiley & Sons, Inc., 111 River Street, Hoboken, New Jersey, NY, 2014.</td></tr>
<tr><td>Quality assurance</td><td colspan="3">Quality of the teaching and learning, monitored at the level of the (1) teachers, accepting suggestions of students and colleagues, and (2) faculty, conducting surveys of students on teaching quality.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

Subject name	Analytical chemistry II					
ID	PMC104	Study year	2.			
Lecturer	doc. dr. sc. Ivana Mitar	Points value (ECTS)	4.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			30	15	0	0
Subject status	Compulsory	Online percentage	10%			
Subject description						
Subject goals	Understanding of basic principles and application of quantitative laboratory and instrumental methods.					
Enrolment requirements	Completed course General Chemistry I and II.					
Learning outcomes	The student will be qualified to: 1.understand and explain the theoretical basis of quantitative laboratory and instrumental methods, 2.understand the capabilities and shortcomings of quantitative laboratory and instrumental methods, 3.select appropriate methods by types of analytes and other test parameters, and 4.participate in the explanation and interpretation of the results of analytical results.					
Syllabus	LECTURES: 1.Quantitative chemical analysis: Titrimetric methods of analysis Titration, equivalence point and end point, primary and secondary standards, standardization of solutions, indicators, titration curves. 2.Acid-base titrations Primary and secondary acid-base titration standards, acid-base indicators, titration curves (calculation of pH during titration). 3.Complexometric titrations EDTA, Y4- pH dependence, complexometric indicators, titration curves (calculation of pM during titration), influence of other complexing species on the reaction of metal ions with EDTA. 4.Titrations based on precipitation equilibria Indicators in precipitation titrations, prediction of titration curves in argentometric titrations. 5.Quantitative chemical analysis: gravimetric methods Properties of precipitation reagents (specific, selective, organic, inorganic), types of precipitates, gravimetric factor. 6.Titrations based on reduction-oxidation equilibria Primary and secondary standards for redox titrations, indicators in redox titrations, titration curves. 7.Introduction to instrumental analysis 8.Electroanalytical methods Classification of electroanalytical methods. 9.Potentiometry Fundamentals of potentiometric measurements, reference, indicator, or inert electrodes.					

	10.Electrogravimetry Fundamentals and classification of electrogravimetric measurements. 11.Introduction to the spectroscopic method Electromagnetic radiation, electromagnetic spectrum, classification of spectrometric methods, instruments in spectroscopy. 12.UV/Vis spectroscopy UV/Vis spectrophotometer, Beer-Lambert law, calibration curve. 13.IR spectroscopy IR spectrophotometer, molecular vibrations, IR spectra interpretation. 14.Introduction to chromatographic methods Fundamentals and classification of chromatographic measurements. 15.Gas chromatography, GC and Liquid chromatography, HPLC SEMINAR: Solving numerical examples related to the theoretical material covered.
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Students are required to attend class (lectures 80% and seminars 100%) and actively participate in the teaching process. This will be recorded and evaluated in a final assessment.

Monitoring student work

Class attendance	0.5	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam	2.0		
Written exam	1.5	Project			

Assessment and evaluation of student work	The final grade for the course will consist of a written (seminar) and an oral part (lecture). The written part may be taken in whole or in part by partial examinations during the semester. The exams will be graded as follows: more than 60% - adequate, more than 70% - good, more than 80% - very good and more than 90% - excellent. The oral part of the examination is taken by the students after successfully passing the written examination (partially or completely).

Required literature	Title	Number of copies available	Availability on other medium
	D.A. Skoog, D.M. West, F.J. Holler, Osnove analitičke kemije, Školska knjiga, Zagreb, 1999.		
Supplementary literature	1.R. Kellner, J. M. Mermet, M. Otto, M. Valcarcel and H. M. Widmer, Analytical Chemistry (A Modern Approach to Analytical Science, Second Edition), Wiley-VCH Verlag Gmbh & Co. KGaA, Weinheim, 2004. 2.D. C. Harris, Quantitative Chemical Analysis, W. H. Freeman and Company, 41 Madison Avenue New York, NY, 2016. 3.B. M. Tissue, Basic of Analytical Chemistry and Chemical Equilibria, John Wiley & Sons, Inc., Hoboken, New Jersey, NY, 2013. 4.G. D. Christian, P. K. Dasgupta, K. A. Schug, Analytical Chemistry, John Wiley & Sons, Inc., 111 River Street, Hoboken, New Jersey, NY, 2014.		
Quality assurance	Quality of the teaching and learning, monitored at the level of the (1) teachers, accepting suggestions of students and colleagues, and (2) faculty, conducting surveys of students on teaching quality.		
Other (in the opinion of the proponent)			

Subject name	Analytical methods		
ID	PMC223	Study year	2.
Lecturer	doc. dr. sc. Ivana Mitar	Points value (ECTS)	4.0
Associates		Class execution (number of hours in semester)	L: 30, S: 15, E: 30, P: 0
Subject status	Compulsory	Online percentage	10%
Subject description			
Subject goals	Understanding of basic principles and application of classical methods of qualitative and quantitative analysis and basic instrumental methods.		
Enrolment requirements	Completed course Basic and Inorganic Chemistry.		
Learning outcomes	Upon completion of the course, students will be able to: 1.define the basic concepts of analytical chemistry, 2.distinguish between quantitative and qualitative analysis, 3.explain the physical and chemical principles of each method of classical analysis, 4.participate in the selection of the appropriate analytical method, depending on the nature of the sample to be analyzed, 5.understand and apply appropriate laboratory or instrumental methods, and 6.participate in the calculation, explanation, and interpretation of analytical results.		
Syllabus	LECTURES: 1.Definition, importance, and classification of analytical chemistry Chemical analysis: qualitative and quantitative Analytical process (problem definition, sampling, choice of analytical methods, analytical signal, report) Safety of laboratory work 2.Chemical equilibrium Equilibrium constants 3.Acid-base equilibria Acid and base strength; autoprotolysis of water. 4.Activity and activity coefficient Ionic strength of the solution 5.Acid-base buffer Buffer preparation; buffer capacity 6.Salt hydrolysis Hydrolysis constant. 7.Equilibria of complex formation		

<table>
<tr>
<td></td>
<td colspan="3">Individual and sum constants of stability of complexation
8.Equilibrium between a solid, poorly soluble substance and its ions
Solubility, solubility product constant
9.Oxidation-reduction equilibria
Standard electrode potential, electrode potential, Nernst equation
10.Quantitative chemical analysis
11.Titrimetric methods of analysis
Titration, equivalence point, end point; primary and secondary standards; standardization of solutions; indicators; titration curves.
Classification of titrimetric methods
12.Gravimetric methods
Precipitation reagents; types of precipitate; gravimetric factor
13.Electroanalytical methods
Potentiometry; electrogravimetry
14.Spectroscopy
Basic principles of UV / VIS and IR spectroscopy.
15.Chromatography
Basic principles of surface and column chromatography (HPLC, GC).

SEMINAR: Solving numerical examples related to the theoretical material covered.

EXERCISE:
1.Basic actions in the laboratory of quantitative chemical analysis
2.Basic principles of solution preparation and safety in the laboratory
3.Preparation of solutions for quantitative analysis
4.Preparation of buffer solutions
5.Hydrolysis of salts
6.Standardization of titrants: hydrochloric acid and sodium hydroxide
7.Alkalimetry: determination of ascorbic acid
8.Complexometry: determination of water hardness
9.Methods based on precipitation reactions: determination of chloride ions according to Mohr method
10.Methods based on redox reactions: determination of ascorbic acid
11.Electrogravimetric separation of copper and nickel in the sample
12.Spectrophotometric determination of copper
13.Spectrophotometric determination of iron
14.Pigment analysis by IR spectrophotometry
15.Exercise review</td>
</tr>
<tr>
<td>Teaching types</td>
<td>☑ Lectures</td>
<td>☐ Fieldwork</td>
<td>☐</td>
</tr>
</table>

	☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring	☐ ☐ ☐
Student obligations	Students are required to attend classes (lectures and seminars 80 %, laboratory practice 100 %) and actively participate in the teaching process. That will be recorded and evaluated in making a final assessment		

Monitoring student work						
	Class attendance	0.5	Research		Practical work	1
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	1		
	Written exam	1.5	Project			

Assessment and evaluation of student work	All laboratory exercises must be completed. The grade for the laboratory exercises will be based on the laboratory work. The final grade for the course will consist of a written (seminar) and an oral part (lecture) and laboratory examination. The written part may be taken in whole or in part by partial examinations during the semester. The exams will be graded as follows: more than 60 % – adequate, more than 70 % – good, more than 80 % – very good and more than 90 % – excellent. The oral part of the examination is taken by the students after successfully passing the written examination (partially or completely).

Required literature	Title	Number of copies available	Availability on other medium
	D. A. Skoog, D. M. West, F. J. Holler, Osnove analitičke kemije, Školska knjiga, Zagreb, 1999.	10	
	I. Mitar, Laboratorijske vježbe za kolegije iz analitičke kemije (interna, nerecenzirana skripta)		

Supplementary literature	1.R. Kellner, J. M. Mermet, M. Otto, M. Valcarcel and H. M. Widmer, Analytical Chemistry (A Modern Approach to Analytical Science, Second Edition), Wiley-VCH, Verlag Gmbh & Co. KGaA, Weinheim, 2004. 2.D. C. Harris, Quantitative Chemical Analysis, W. H. Freeman and Company, 41 Madison Avenue New York, NY, 2016. 3.B. M. Tissue, Basic of Analytical Chemistry and Chemical Equilibria, John Wiley & Sons, Inc., Hoboken, New Jersey, NY, 2013.

	4.G. D. Christian, P. K. Dasgupta, K. A. Schug, Analytical Chemistry, John Wiley & Sons, Inc., 111 River Street, Hoboken, New Jersey, NY, 2014.
Quality assurance	Quality of the teaching and learning, monitored at the level of the (1) teachers, accepting suggestions of students and colleagues, and (2) faculty, conducting surveys of students on teaching quality.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Learning Analytics in Computer Based Education</td></tr>
<tr><td>ID</td><td>PMIK25</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Ani Grubišić</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The aim is to acquire knowledge about the application of learning analytics in a Computer Based Education.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Course enrolment requirements: None
Entry competences: basic usage of computer</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Describe learning analytics and how it differs from related concepts such as educational data mining.
Analyze, plan, and deploy a small learning analytics pilot, including the intent of LA and tools needed to address analytics goals.
Develop a matrix of prominent learning analytics tools and the particular analytics strategies each tool addresses.
Evaluate current state of learning analytics technologies and describe the benefits and drawbacks to open source and proprietary tool sets.
Evaluate and describe the role of learning analytics in intelligent tutoring systems.
Conduct basic analytics activities (such as importing and visualizing data) through in open source tools (R).
Interpret data collected in e-learning systems.
Examine data sets to gain insight into how students are involved in e-learning systems.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Learning analytics: definition, dimensions, framework (2h L)
Predictive Modeling in Learning Analytics: Big Data and Education, Regressors, Classifiers (4h L, 4h E)
Model Validation: Confidence, Diagnostic, Over-Fitting (4h L, 4h E)
Behavior Detection, Data Synchronization, Knowledge Engineering (2h L, 2hE)
Knowledge Inference: Bayesian Knowledge Tracing, Performance Factor Analysis (4h L, 4h E)
Relationship Mining: Correlation Mining, Causal Mining, Sequential Pattern Mining, Network Analysis (4h L, 4h E)
Structure Discovery: Clustering, Validation and Selection, Factor Analysis (4hL, 4h E)
Learning analytics dashboard: Learning Curves, Moment by Moment Learning Graphs, Scatter Plots, State Space Diagrams (4h L, 4h E)
Using Data to Provide Personalized Student Support (4h L, 4h E)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online</td><td>☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory</td><td colspan="4">
☐
☐
☐</td></tr>
</table>

	☐ Combined online		☐ Mentoring		☐	
Student obligations						
Monitoring student work	Class attendance	2	Research	0.5	Practical work	1
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	0.5	Oral exam	0.5		
	Written exam	0.5	Project			
Assessment and evaluation of student work	Homeworks (25%) Project report (25%) Written exam (50%)					

Required literature	Title	Number of copies available	Availability on other medium
	The Handbook of Learning Analytics, Editors: Charles Lang, George Siemens, Alyssa Wise, Dragan Gašević, ISBN: 978-0-9952408-0-3, DOI: 10.18608/hla17		Online
	Baker, R.S. (2018) Big Data and Education. 4th Edition. Philadelphia, PA: University of Pennsylvania.		Online

Supplementary literature	Nisbet, R., Elder, J., Miner, G. (2009). Handbook of Statistical Analysis & Data Mining Applications. Elsevier, Inc: London UK. ISBN-13: 978-0123747655 Sclater, N. (2017). Learning Analytics Explained. New York, USA: Taylor & Francis.
Quality assurance	Conversations with students, anonymous student survey, exam performance, self-analysis.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Complex networks analysis</td></tr>
<tr><td>ID</td><td></td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Tanja Vojković</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The objective of this course is to introduce students to new and fast growing field of complex networks. Mathematicaly, complex network is a graph, so concepts and results from graph theory are largely used. Students will learn about basic notions of networks and their analysis through lectures and through auditory excercises and homeworks they will pratice tools for analysis, vertex centrality measures, imoportant edges and paths, community detection and epidemic models.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Graph theory course and Data structure and algorithms course must be passed, and knowledge of basic algotihm complexity is preferable.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students will be able to:
- explain the importance of complex networks and motivation for their analysis
- explain basic measures for structure of complex netwotks
- implement basic algorithms for analysis
- explain the process and methods of community detection and know basic algorithms for community detection
- talk about models of epidemic spread</td></tr>
<tr><td>Syllabus</td><td colspan="6">- Introduction to complex networks, types and properties, classification - 2 hours
- Network representation, Laplacian, eigenvalues - 4 hours
- Measures and metrices (centrality)- 6 hours
- Basic algorithms on networks - 5 hours
- Groups of vertices (cliques, cores, components, transitivity, clustering) - 8 hours
- Substructures (communities, components) - 6 hours
- Complex algorithms on networks - 8 hours
- Processes on networks (epidemics, SI, SIR, SIRS) - 6 hours</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures</td><td>☐ Fieldwork</td><td colspan="4">☐</td></tr>
</table>

	☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐
Student obligations	Pohađanje nastave, rješavanje domaćih zadaća		

Monitoring student work						
	Class attendance	1	Research		Practical work	2
	Experimental work		Paper		Domaće zadaće	2
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	The exam which requires solving practical and theoretical through homework and an oral theoretical exam. Passed homework is a prerequisite for the oral exam.

Required literature	Title	Number of copies available	Availability on other medium
	M.E.J. Newman: Networks, An Introduction, Oxford University Press, London, 2010.		

Supplementary literature	D. Veljan: Kombinatorna i diskretna matematika A. Golemac: Teorija grafova, skripta
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Data Analysis in High Energy Physics</td></tr>
<tr><td>ID</td><td>PMP272</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Toni Šćulac</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Teaching students basics of data analysis in high energy physics.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Introduction to elementary particles.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students are expected to:
– Understand and describe how LHC works
– Understand basics of the Standard Model
– Explain the workflow of data analysis
– Know how to work with the ROOT programming package
– Understand probability theory: frequentist and Bayesian
– Understand Monte Carlo simulation
– Explain particle interactions with matter
– Explain estimators, likelihood, maximum likelihood, and extended maximum likelihood method
– Explain confidence intervals and know how to determine them for different estimators – Explain Neymann and Bayesian confidence intervals
– Explain hypothesis testing and p-value</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. LHC physics and the Standard Model
2. Data analysis in HEP
3. ROOT programming package
4. Probability and statistics
5. Monte Carlo simulations in HEP
6. Distributions and estimators
7. Likelihood, maximum likelihood and extended maximum likelihood methods
8. Confidence intervals 9
9. Hypothesis testing and p-value</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online</td><td>☐ Fieldwork
☑ Individual assignments
☑ Multimedia
☐ Laboratory</td><td colspan="4">☐
☐
☐
☐</td></tr>
</table>

	☐ Combined online		☐ Mentoring			
Student obligations	Attend at least 70% of lectures and 70% of exercises.					
Monitoring student work	Class attendance	2	Research		Practical work	2
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	1		
	Written exam	1	Project			
Assessment and evaluation of student work	The final grade is formed after the student passes both test parts: – written exam (problem solving on computer, 50% rating) and – oral exam (theory, 50% rating).					
Required literature	Title				Number of copies available	Availability on other medium
	Statistical Data Analysis, Oxford Science Publications, 1st edition, Glen Cowan					
Supplementary literature	Slides from lectures.					
Quality assurance	Anonymous student questionnaire and course evaluation performed by the University of Split.					
Other (in the opinion of the proponent)						

Subject name	Neural Network Architectures					
ID	PMII15	Study year	2.			
Lecturer	doc. dr. sc. Goran Zaharija	Points value (ECTS)	5.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			30	0	30	0
Subject status	Elective	Online percentage	0%			
Subject description						
Subject goals	Recent advances in Artificial neural networks and deep learning have fundamentally changed the field of machine learning, especially with regarding the range of applications in which they offer superior performance. This course offers a practical overview of modern machine learning methods with special emphasis on deep learning approaches. Through the course, students will become familiar with the most commonly used neural network architectures and will create their own models of these architectures through practical examples.					
Enrolment requirements						
Learning outcomes	After passing the course, students will be able to: 1. recognize the basic models of deep machine learning: convolutional neural networks (CNN), feedback and recursive neural networks (RNN, LSTM, GRU), and generative neural networks (GAN) 2. describe the basic algorithms for learning in deep neural networks, based on gradient descent (BP, BPTT) 3. explain the principles of robust deep learning using regularization in neural networks (L1, L2, dropout, blackout) 4. analyze and evaluate neural networks intrinsically and extrinsically 5. implement solutions based on deep learning using modern software libraries (Keras, TensorFlow) 6. form solutions based on deep neural networks, using various data sources like images, text, and similar unstructured data					
Syllabus	1. Introduction and course overview (2+2) 2. Multilayer perceptron (MLP) and backpropagation (BP) (2+2) 3. Approaches to the regularization of neural networks (2+2) 4. Learning Optimizations in neural networks (2+2) 5. Convolutional neural networks (CNN) (2+2) 6. Recurrent neural networks (RNN) and learning by backpropagation through time (BPTT) (2+2) 7. Recursive neural networks (2+2) 8. Vanishing gradients problem and advanced variants of neural networks (long short-term memory, LSTM, en. gated recurrent unit, GRU) (2+2) 9. Generative neural models of deep learning (generative adversarial networks, GAN) (2+2) 10. Simultaneous learning with neural networks (en. multi-task learning, MTL) (2+2) 11. Learning vector descriptions of data (2+2)					

	12. Practical deep learning, parameters, and evaluation (2+2) 13. In-depth learning in image, text, and speech processing (2+2) 14. Limitations of deep learning and active areas of research (2+2) 15. Exam preparation (2+2)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Regular class attendance, practical assignment

Monitoring student work:

Class attendance	1.5	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums	0.5	Oral exam			
Written exam	2	Project	1		

Assessment and evaluation of student work:

Tasks (25%)
Project (25%)
Written exam (50%)
Students must pass each of the components

Required literature:

Title	Number of copies available	Availability on other medium
Goodfellow, Bengio, Courville: Deep learning. 2016.		https://www.deeplearningbook.org/
Bishop. Pattern Recognition and Machine Learning. Springer, 2010		
Murphy. Machine Learning: A Probabilistic Perspective. MIT Press, 2012.		
Daume III: A Course in Machine Learning. 2015.		http://ciml.info/

Supplementary literature	Scientific and popular papers in the field of deep machine learning.
Quality assurance	Conversation with students, student evaluation using an anonymous survey, self-assessment.

Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Astroparticle Physics</td></tr>
<tr><td>ID</td><td>PMP133</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivana Weber</td><td>Points value (ECTS)</td><td>6.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 30
S: 0
E: 30
P: 0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>0%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3"></td></tr>
<tr><td>Enrolment requirements</td><td colspan="3"></td></tr>
<tr><td>Learning outcomes</td><td colspan="3"></td></tr>
<tr><td>Teaching types</td><td>☐ Lectures
☐ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3"></td></tr>
<tr><td>Monitoring student work</td><td colspan="3">Class attendance | Research | Practical work
Experimental work | Paper |
Essay | Seminar paper |
Colloquiums | Oral exam |
Written exam | Project |</td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="3"></td></tr>
<tr><td>Required literature</td><td colspan="3">Title | Number of copies available | Availability on other medium
–</td></tr>
<tr><td>Supplementary literature</td><td colspan="3"></td></tr>
<tr><td>Quality assurance</td><td colspan="3"></td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

Subject name	Atmospheric pollution					
ID	PMP16D	Study year	1.			
Lecturer	izv. prof. dr. sc. Žarko Kovač	Points value (ECTS)	4.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			30	0	15	0
Subject status	Elective	Online percentage	30%			
Subject description						
Subject goals	Provide knowledge on – Characteristics of the atmosphere and air quality – Main atmospheric pollutants – Effects of pollutants on health effects – Ozone in the atmosphere – Main chemical reactions of pollutants in the atmosphere – Modeling transport and dispersion of atmospheric pollutants Provide knowledge on					
Enrolment requirements	Prerequisites – Basic physics – Basic meteorology – Basic chemistry Prerequisites – Basic physics – Basic meteorology – Basic chemistry					
Learning outcomes	1. Understanding main characteristics of air pollution. 2. Awareness on human health degradation caused by atmospheric pollutants. 3. Knowledge on chemical reactions and processes relevant to air quality. 4. Ability to analyze modeling results and to construct a simple dispersion model.					
Syllabus	1. Chemical elements and compounds in the atmosphere (1h) 2. Structure of the atmosphere (1h) 3. Ideal gas laws (3h) 4. Chemical elements and compounds relevant to air pollution and health impacts (5h) 5. Aerosols in the atmosphere (5h) 6. Ozone in the atmosphere (5h) 7. Modeling air pollution (3h) 7.1 Gaussian models of dispersion (3h) 7.2 Numerical models based on higher-order closures (1h) 7.3 Lagrangian stochastic models of dispersion (2h)					

	7.4 Forecasting air pollution using photochemical models (1h)
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☑ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring
Student obligations	Attending all forms of teaching.

Monitoring student work

Class attendance	1	Research		Practical work	
Experimental work		Paper			
Essay	1	Seminar paper			
Colloquiums		Oral exam	2		
Written exam		Project			

Assessment and evaluation of student work	The grade is determined on the basis of grades: – oral presentations, – homework.

Required literature

Title	Number of copies available	Availability on other medium
Jacobson, M. Z., 2012: Air Pollution and Global Warming. Cambridge University Press. 375 pp.		
Turner, B. D., 1970: Workbook of Atmospheric Dispersion Estimates. U.S. Department of Health, Education and Wealthfare. 95 pp.		

Supplementary literature	
Quality assurance	1. Analysis of the acquired learning outcomes at the end of the class, compared with the work of students. 2. Monitoring the development of students in the subjects who followed the links with the success of the case 3. Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.
Other (in the opinion of the proponent)	

Subject name	Biophysics					
ID	PMP141	Study year	1.			
Lecturer	izv. prof. dr. sc. Larisa Zoranić	Points value (ECTS)	6.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			45	15	30	0
Subject status	Elective	Online percentage	10%			
Subject description						
Subject goals	Understanding the structure and function of macromolecules and biological complexes, and their role in cellular processes using physical models.					
Enrolment requirements	Basic knowledge of molecular biology, biochemistry, classical mechanics, electrodynamics, quantum and statistical mechanics.					
Learning outcomes	After successfully completing the course, the student will be able to: 1. recognize and define some of the models in biophysics that describe the structure and function of biological molecules and systems 2. explain and evaluate basic physical models that describe biological processes 3. independently solve some of the simple problems in biophysics 4. understand, evaluate and present scientific research in biophysics					
Syllabus	Lesson plan by week: 1. Introductory lessons, basic biological molecules, the basis of the cell, spatial and temporal scales in biology, models in biology 2. Energies in biology, basics of metabolism, mechanical and chemical equilibrium, local equilibrium, application of thermodynamics and statistical mechanics in biology, examples of ligand binding, two-state model and membrane channels. 3. Global states, global transitions, chemical potential and free energy, van't Hoff relations 4. Binding models, cooperative and sequential binding, Hill coefficients. Allosteric reactions. 5. Models of myoglobin and hemoglobin. Law of mass action. Osmosis. 6. Random walk model, effective length, Kuhn length, persistence length, radius of gyration, Gaussian distribution, Brownian motion and connection with diffusion. 7. Protein structure, HP and hc models. Forces in proteins. Hydrophobicity, hydrophobic effect, hydrophobic force. 8. Electrostatic contributions in biological systems. pH and pK values, free and electrostatic energy. Poisson-Boltzmann equation. 9. Bioelectricity, Nernst equation, voltage gated channels. 10. Action potential, circuit model, membrane potential model, bistable behavior of Na+ and K+ ion currents. The cable equation 11. Diffusion models, Einstein's model, Smoluchowski's model.					

	12. Chemical kinetics, reaction rates, reaction rate, reaction coordinate, Arrhenius behavior, example of retinal isomerization in photosynthesis, macroscopic and microscopic dynamic model. 13. Dynamic models. Michelis-Menten enzyme kinetics. 14. Biological membranes, models of the structure and function of membranes and vesicles. 15. Selection of a topic of choice: photosynthesis, molecular motors, biological networks, biological samples and others according to the students' interest.
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Attendance and commitment of students in class, preparation and presentation of seminars, discussion of scientific articles.

Monitoring student work

Class attendance	2	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper	1		
Colloquiums	1	Oral exam	2		
Written exam		Project			

Assessment and evaluation of student work	The conditions for passing the exam are: passing the colloquium or written exam, written and presented assignments and seminars, and passing the oral exam.

Required literature

Title	Number of copies available	Availability on other medium
Physical Biology of the Cell, Rob Phillips, Jane Kondev, Julie Theriot and Hernan G. Garcia, Garland Science, Taylor & Francis Group, 2013.	3	

Supplementary literature	1. Molecular and Cellular Biophysics Meyer B. Jackson University of Wisconsin Medical School, Cambridge University Press 2006 . 2. Bioenergetika, rad membranskih proteina Juretić Davor, Informator, Zagreb, 1997. 3. Glaser, R. “Biophysics”. Springer-Verlag, Berlin, 2001. 4. Fersht, A. “Structure and mechanism in protein science”, Freeman and Company, New York, 1998. 5. Volkenshtein, M.V. “Biophysics”, Mir Publishers, Moscow 1983. 6. Hill, T.L. Free “Energy Transduction in Biology”, Academic Press, New York 1977. 7. Molekularna biofizika , Antonio Šiber , script, 2012..

	8. Scientific articles, lectures
Quality assurance	The success of the program is monitored by the quality of knowledge demonstrated in the exams, as well as by the assessment of the demonstrated enthusiasm for the subject, through conversations with students, and by monitoring the student's progress during classes. External evaluation includes student surveys.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Biophysics of Hearing and Speech</td></tr>
<tr><td>ID</td><td>PMP247</td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Damir Kovačić</td><td>Points value (ECTS)</td><td>5.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 35, S: 5, E: 10, P: 0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>0%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Upoznati studente s temeljnim pojmovima biofizikalnih mehanizama slušanja i produkcije govora; istraživačkim metodama u području biofizike slušanja i govora</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Upisan jedan od diplomskih studija Položena Opća fizika III (valovi)</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">• Definirati fizikalne parametre zvuka, te govora kao posebne zvučne kategorije • Opisati svojstva jednostavnih i složenih zvukova • Objasniti spektralnu analizu zvukova i govora • Opisati glavne elemente slušnog sustava • Razumjeti glavne procese odgovornih za neuralnu podlogu slušanja • Nabrojiti istraživačke metode u području biofizike slušanja i govora • Povezati istraživačke metode sa znanstveno-istraživačkim pitanjima</td></tr>
<tr><td>Syllabus</td><td colspan="3">Predavanje (6h): Akustika Predavanje (6h): Fiziologija slušanja Predavanje (6h): Periferni i centralni slušni sustav Predavanje (6h): Auditorna percepcija i produkcija govora Predavanje (6h): Metode istraživanja slušanja i govora Seminar (2h): Prikaz metoda za snimanje i prikaz akustičkih i govornih podražaja Seminar (2h): Biofizikalni modeli kohlearne mehanike Seminar (1h): Neuroinženjering i nove tehnologije u slušanju i govoru (kohlearni implantati) Vježbe (2h): Spektralna analiza zvuka i govora Vježbe (2h): Govorna audiometrija Vježbe (2h):Biofizikalne tehnike snimanja slušnih stanica i auditornih neurona Vježbe (2h): Demonstracija rada kohlearnog implantata Vježbe (2h): Demonstracija 3D navigacijske transkranijalne magnetske stimulacije</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☑ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Student je dužan pohađati predavanja, seminare i vježbe, s najviše 20% opravdanih izostanaka. Student je dužan položiti kolokvij. Po položenom kolokviju, student je dužan napisati seminarski rad po odabranoj temi i izložiti ga u obliku prezentacije pred kolegama i nastavnikom.</td></tr>
<tr><td>Monitoring student work</td><td colspan="3">Class attendance | | Research | | Practical work |
Experimental work | | Paper | | |
Essay | | Seminar paper | | |</td></tr>
</table>

<table>
<tr><td></td><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td></td><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Ocjena se utvrđuje na temelju ocjena: • Kolokvija (25% ocjene) • Seminarskog rada (50% ocjene) • Usmene prezentacije (25% ocjene)</td></tr>
<tr><td rowspan="2">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">William Yost: Fundamentals of Hearing Science</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">• Brian C. J. Moore: An introduction to the psychology of hearing • Jan Schnupp, Israel Nelken & Andrew King: Auditory Neuroscience – Making Sense of Sound • James O. Pickles: An introduction to the physiology of hearing • Daniel J. DiLorenzo and Joseph D. Bronzino: Neuroengineering • Izabrani znanstveni članci</td></tr>
<tr><td>Quality assurance</td><td colspan="6">• Vrednovanje rezultata u skladu s navedenim ishodima učenja • Povratna informacija od studenata putem ankete • Samoevaluacija nastavnika • Institucijske i izvaninstitucijske provjere</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">Bioinformatics</td></tr>
<tr><td>ID</td><td>PMP140</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Željka Sanader Maršić</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Glavni cilj kolegija je upoznati studente s dostupnim alatima koje bioinformatika nudi za potrebe analiziranja sekvence i strukture proteina te nukleinskih kiselina kako bi do kraja kolegija bili samostalni u izvođenju analiza. Kolegij će predstaviti alate strukturne bioinformatike, filogenetike te genomike i proteomike.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Za uspješno praćenje kolegija bioinformatike potrebno je predznanje biokemije i biofizike. Točnije, potrebno je poznavanje strukture i fizikalno-kemijskih svojstava nukleotida i aminokiselina što je pokriveno prethodno odslušanim kolegijima studenata.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Nakon završenog kolegija studenti bi trebali:
1) Poznavati biološke baze podataka
2) Poznavati alate za uspoređivanje sekvenci nukleinskih kiselina
3) Poznavati alate za uspoređivanje sekvenci proteina
4) Predviđati strukturu proteina
5) Razumjeti filogenetska stabla i njihovu konstrukciju
6) Razumjeti sekvenciranje i mapiranje genoma
7) Biti samostalni u odabiru alata prema potrebama analize
8) Biti samostalni u interpretaciji rezultata dobivenih korištenjem bioinformatičkih alata
9) Razviti kritičnost prema javno dostupnim bioinformatičkim alatima, tj. Biti sposobni za prepoznavanje lažno-negativnih i lažno-pozitivnih rezultata</td></tr>
<tr><td>Syllabus</td><td colspan="6">Tjedni plan nastave:
1) Uvod u bioinformatiku, upoznavanje s poviješću i razvojem te definicija područja
2) i 3) Upoznavanje s bazama podataka: literaturne baze podataka, baze podataka genskih i proteinskih sekvenci, proteinskih struktura, funkcionalnih domena te cjelovitih genoma
4) i 5) Jednostavno i multiplo poravnavanje sekvenci nukleinskih kiselina i proteina, različiti algoritmi i alati za poravnavanje sekvenci
6) i 7) Predviđanje sekundarne i tercijalne strukture proteina: modeliranje po homologiji te alati koji se koriste za navedena predviđanja
8) i 9) Programi za vizualizaciju strukture proteina
10) i 11) Osnove molekularne filogenetike i algoritmi za konstrukciju filogentetskih stabala
12) i 13) Mapiranje, sekvencioniranje i anotacija genoma te funkcionalna genomika</td></tr>
</table>

	14) i 15) Analiza ekspresije proteina na razini proteoma, posttranslacijske modifikacije
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring
Student obligations	Prisustvo i zalaganje studenta na satu, izrada zadataka na satu, izrada zadataka kod kuće, izrada seminara koji uključuje samostalno istraživanje nekog fizikalnog problema, pisanje izvještaja i prezentacija istog.
Monitoring student work	(see table below)
Assessment and evaluation of student work	Uvjeti za polaganje ispita su: sposobnost korištenja postojećih bioinformatičkih alata. Ocjenjivanje kroz vježbe na računalu, domaće zadaće i završni seminar. Ocjena se zaključuje prema ocjeni studentskog zalaganja u nastavi i ocjeni seminara.
Required literature	(see table below)
Supplementary literature	[1] Supratim Choudhuri: Bioinformatics for Beginners; Academic Press; 2014, Elsevier Inc. [2] Znanstveni članci, predavanja
Quality assurance	Ocjenjivanje studenta putem anonimnih upitnika na kraju kolegija.
Other (in the opinion of the proponent)	

Monitoring student work

Class attendance		Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam			
Written exam		Project			

Required literature

Title	Number of copies available	Availability on other medium
Arthur Lesk: Introduction to Bioinformatics; Oxford University Press; Great Clarendon Street, Oxford, OX2 6DP, United Kingdom	5	
Charles Cantor: Biophysical Chemistry Part I, The Conformation of Biological Macromolecules; W.H.Freeman, 1980	5	
Charles Cantor: Biophysical Chemistry Part I, The Conformation of Biological Macromolecules; W.H.Freeman, 1980	5	

<table>
<tr><td>Subject name</td><td colspan="6">Biological oceanography</td></tr>
<tr><td>ID</td><td>PMB513</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Antonela Sovulj</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The aim of the course is to introduce students to the biology of marine organisms and their role in the ecosystem. Introduce them to the origins of life in the seas, with an emphasis on importance of individual groups in marine planktonic and benthic communities ecosystems, adaptations of organisms to different habitats and human impact.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After the course the student will be able to:
• Define and describe the basic concepts of marine biology and oceanography.
• Analyze and understand biotic ocean systems and the organisms that inhabit them.
• Analyze the ways in which organisms inhabit ocean ecosystems.
• Connect the adaptations of organisms and their habitats.
• Understand marine biogeochemical cycles.
• Analyze the oceanography and biology of the Adriatic and Mediterranean Seas.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Introduction to oceanography and marine biology.
2. Sea bed.
3. Chemical and physical aspects of sea water and world oceans.
4. Oceanic environments considering topography.
5. Zoning of oceanic environments considering bathymetry.
6. Wildlife in the sea and settlement zones.
7. The role of marine organisms in biogeochemical processes.
8. Ecological regulators of distribution of marine organisms in the sea. 9. Structure and role of marine ecosystems.
10. Estuaries and sea spray area, coral reefs.
11. Coastal sea and continental shelf.
12. Open Sea Organisms.
13. Life in the depths of the sea.
14. Hazards to ocean ecosystems.
15. Oceanography and biology of the Adriatic and Mediterranean seas.</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars</td><td colspan="2">☐ Fieldwork
☐ Individual assignments</td><td colspan="3">☐</td></tr>
</table>

	Exercises Fully online Combined online		Multimedia Laboratory Mentoring			
Student obligations						
Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	1		
	Colloquiums		Oral exam	1		
	Written exam	1	Project			
Assessment and evaluation of student work	The written part of the seminar paper is evaluated (topic processing and paper structure; graphic and other attachments; literature), presentation of seminar paper and written and oral exam.					

Required literature	Title	Number of copies available	Availability on other medium
	Karleskint, G., Turner, R., Small, J 2006. Introduction to Marine Biology. Thomson brooks/Cole		
	Castro, P., Huber, M. E., 2005. Marine Biology. McGraw-Hill, New York.		
	Miller, C. B., 2004. Biological oceanography. Blackwell, Oxford.		
Supplementary literature	Peres, J. M., Gamulin-Brida, H. 1973. Biološka oceanografija. Školska knjiga, Zagreb. Viličić, D. 2002. Fitoplankton Jadranskog mora. Školska knjiga Zagreb. Viličić, D. 2003. Fitoplankton u ekološkom sustavu mora. Školska knjiga Zagreb.		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Cytogenetic Chromosome Analysis</td></tr>
<tr><td>ID</td><td>PPB253</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivica Šamanić</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>10</td><td>5</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Insight into the molecular and structural dynamics of mitotic and meiotic chromosomes.
Theoretical and practical introduction of students with the classical and molecular cytogenetic techniques.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Student will be able to:
1. The integration and implementation of all the knowledge acquired during
the various courses (primarily Cell biology, Genetics and Molecular biology)
for studying genomes at the level of chromosomes and chromatin.
2. Explain the importance of cytogenetics in the area of basic research as well
as its applications in medical genetics, biotechnology and agriculture
3. The skills and knowledge acquired throughout the training will enable
students to perform in situ hybridization and other molecular techniques needed to work in the Molecular and Cytogenetic laboratories (employment of cytogenetic technologists or clinical laboratory technicians).
4. The acquired knowledge and skills will form the bases for further research in the field.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures:
1. CYTOGENETICS METHODS:
Molecular cytogenetic techniques;
In situ hybridization (FISH, GISH, direct visual in situ hybridization (DIRVISH) on elongated DNA fibers), in situ PCR, PRINS (PRimed IN Situ labeling), Flow cytometry, Chromosome microdissection.
Classical cytogenetic techniques; chromosome preparations, karyotyping, G-(Giemsa), R-(reverse), C-(centromere) and Q-(quinacrine) banding, chromosome labeling.
2. CHROMATIN STRUCTURE:
Histones, DNA, nucleosome morphology and higher-level organisation; Heterochromatin and euchromatin, position effect variegation; Functional states of chromatin and alternation in chromatin organization.
3. CHROMOSOME ORGANIZATION:
Metaphase chromosome; centromere and kinetochore, telomere and its maintenance; Telomeres and Aging.
4. CHROMOSOME TERRITORIES: The Arrangement of Chromosomes in the Nucleus: Chromosomal domains (matrix, loop domains) and their functional significance; Dynamics of CT arrangements during postmitotic cell differentiation and in terminally differentiated cells.</td></tr>
</table>

	5. CHROMOSOMAL ABNORMALITIES: Numerical (polyploidy, aneuploidy) and structural alterations (chromosomal rearrangements; deletion, duplication, inversion and translocation; structural abnormality: ring chromosomes and isochromosomes). Exercises: Telomere length analysis directly on chromosomes derived from primary cultured human skin fibroblasts and / or peripheral blood cells using quantitative fluorescence in situ hybridization, Q-PNA-FISH; application of molecular cytogenetic techniques (PCR, gel electrophoresis, immunofluorescence staining); optical fluorescence microscopy, image processing and analysis. Seminars: Seminar is one of the course requirements. Students will have to prepare presentation on topics of the original research paper related to the science unit they are studying. The aim is to develop writing skills and presentation skills needed to effectively communicate the purpose, scope, and conclusions of the project.
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☑ Combined online ☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☑ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Obveze studenata/studentica su redovito pohađanje nastave (predavanja), izvođenje laboratorijskih vježbi i samostalna priprema materijala za seminare.

Monitoring student work

Class attendance	0.5	Research		Practical work	
Experimental work	0.5	Paper			
Essay		Seminar paper	1.0		
Colloquiums		Oral exam			
Written exam		Project			

Assessment and evaluation of student work	Research-based class seminar will be elevated. Students will have to prepare presentation showing background of the problem they are dealing with. The presentation will be scored according to the content of the presentation (key words, critical review of literature, presentation of scientific results), format, innovativeness and language competence as well.

Required literature

Title	Number of copies available	Availability on other medium
Cooper, G.M., Hausman, R.E., 2015: Stanica-molekularni pristup. Šesto izdanje,		

	Medicinska naklada, Zagreb 2015. 2. Metode u molekularnoj biologiji, 2007. Andreja Abramovič Ristov (ur). Institut Ruđer Bošković.		
Supplementary literature	1. Molecular Biology of the Gene, Watson JD,Baker TA, Bell SP, Gann A, Levine M, Losick R, Pearson Education Inc., Benjamin Cummings, 2004. 2. Practical in situ Hybridisation, Schwarcher T, Heslop Harrison P, Bios, Scientific Publisher Ltd. 2000. 3. Plant Cytogenetics, Singh RJ, CRC Press London, 2003. 4. Species Evolution: The Role of Chromsome Change, Max King, Cambridge University Press, 1995. 5. Non radioactive in situ hybridisation application manual, Boehringer Mannheim, 1996.		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Differential equations</td></tr>
<tr><td>ID</td><td>PMM950</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Andrijana Ćurković</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">40%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">To insure that chosen chapters of the subject comprise the most important ideas, results and methods from both viewpoints: theoretical and practical. Highlighting the analysis of second order equations, a balanced exposition should insure transition from memorized formulas to the critical understanding of the fundamental Existence and uniqueness theorem and its proof.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Working knowledge of calculus, gained from a normal two- or three-semester course sequence or its equivalent. An acquaintance with functions of several variables, elementary complex functions and operations with matrices. In internal case: taken courses Mathematics 1 and Mathematics 2
(or DIR I).</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Student should
1. be able to distinguish different types of first order DE and to apply methods for their solving;
2. understand what an initial value problem is, and how to show a given function is a solution to one;
3. recognize a homogeneous LDE with constant coefficients and be able to write down the fundamental solution set;
4. be able to find particular solutions of LDE through the method of undetermined coefficients and variation of parameters;
5. explain what happens to solutions as time tends to infinity;
6. make use of a known solution to reduce the order of HLDE;
7. find power series solutions of second order LDE;
8. use the Wronskian to show whether solutions are linearly independent;
9. be able to write down the solution to the problem $x'=Ax$, $x(t0)=x0$ by means of matrix exponential function;
10. explain in their own words conditions that ensure existence and uniqueness of a solution to the Cauchy problem.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. The notion of DE. Basic mathematical models; direction fields. Classification of DE. (2 hours)
2. First order DE: linear, separable, homogeneous, Bernoulli, Riccati. (2 hours)
3. Differences between linear and nonlinear equations. Exact equations. Introduction to the second order LDE. (2 hours)
4. Algebraic structure of the solution set to homogeneous LDE. Abel's theorem. Linear independence and the Wronskian. (2 hours)
5. Second order homogeneous LDE with constant coefficients. Nonhomogeneous equations: method of undetermined coefficients. (2 hours)</td></tr>
</table>

	6. Method of variation of parameters for second order LDE. General theory of nth order LDE. (2 hours) 7. LDE of nth o rder with constant coefficients. Nonhomogeneous LDE of nth order. (2 hours) 8. Series solutions of second order LDE near ordinary point. (2 hours) 9. Regular singular points. Euler equations. (2 hours) 10. Series solutions of second order LDE near regular singular point. (2 hours) 11. Bessel's equation. Systems of first order DEs. Systems of first order LDEs. (2 hours) 12. Homogeneous linear systems with constant coefficients. (2 hours) 13. The matrix exponential function. Nonhomogeneous linear systems. (2 hours) 14. Proof of the Existence and uniqueness theorem for one-dimensional problem. (2 hours) 15. Existence and uniqueness theorem for a n-dimensional problem; a glance on linear case. (1 hour)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Attending lectures and exercises and taking exams.

Monitoring student work						
	Class attendance	2	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	2		
	Written exam	2	Project			

Assessment and evaluation of student work	During the semester students write two partial tests. Final exam consists of a written and an oral part due for completion within one exam term. Both parts are equally valued in the final grade. Passing written test (score ≥50%) is a necessary condition for taking up an oral exam. At the end of the semester, students who passed both partial tests are admitted directly to the oral exam in an exam term (January/February) of their choice.

Required literature	Title	Number of copies available	Availability on other medium
	W.E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, John Wiley & Sons, Inc., New York, 2012		Elektronski dokument na Moodle podršci

Supplementary literature	1. M. Alić, Obične diferencijalne jednadžbe, skripta, PMF-Zagreb, Matematički odjel, 1994.

	2. D.G. Zill and M.R. Cullen, Differential Equations with Boundary-Value Problems, Brooks/Cole, Cengage 2009.
Quality assurance	Exam results statistics. Students' quality assessment at the end of the semester carried out by the University authorized committee through anonymous polls.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Differential and Integral Calculus I</td></tr>
<tr><td>ID</td><td>PMM152</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Milica Klaričić Bakula</td><td>Points value (ECTS)</td><td colspan="4">8.5</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>60</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The aim of the course is to present differential and integral calculus of real-valued functions of single real variable and its application to various problems.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Prerequisite course: Introduction to Mathematical Analysis</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">The student is able to:

- distinguish and give examples of differentiable and nondifferentiable functions, integrable and non-integrable functions

- apply techniques for computing derivatives of real functions, and definite and indefinite integrals of real functions

- determine the intervals of monotonicity and convexity / concavity of a function and local extrema using differential calculus

- apply differential and integral calculus to solve some geometric problems

- identify conditions for the representation of a function as a power series

- apply power series to solve some problems such as approximation of a definite integral.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Differential calculus (differentiability, derivatives of elementary functions, derivatives of higher orders, basic theorems of differential calculus, intervals of monotonicity and convexity/concavity, local extrema, applications) - 20 (ex. 25)

Integral calculus (concept and basic properties of definite and indefinite integrals, the integration of certain classes of functions, basic theorems of integral calculus, applications of definite integrals, improper integrals, applications) - 20 (ex. 30)

Power series (Taylor series, applications) - 5</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures</td><td>☐ Fieldwork</td><td colspan="4">☑ Problem</td></tr>
</table>

	☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	sets ☐ ☐ ☐
Student obligations	Active engagement in discussions during problem sessions and exercises. Doing homework regularly.		

Monitoring student work

Class attendance	3	Research		Practical work	0.5
Experimental work		Paper		Problem sets	1
Essay		Seminar paper			
Colloquiums	2	Oral exam	2		
Written exam		Project			

Assessment and evaluation of student work

Problem solving during class for extra credit. Midterm written exams or final written exam and final oral exam. Passing the written exam is a prerequisite for the oral exam.

Continuous assessment		
Evaluation elements	Performance (min)	Weight in grade (%)
partial written exams	50	50
problem sets	0	5
short tests	50	10

Final assessment		
Evaluation elements	Performance (min)	Weight in grade (%)
oral exam	50	35

Required literature

Title	Number of copies available	Availability on other medium
G. B. Thomas, Thomas' Calculus, Pearson, 2016.,13. izdanje	2	e-learning
B. Guljaš, Matematička analiza 1 i 2, skripta PMF -a u Zagrebu, 2018.	0	e-learning
S. Abbott, Understanding analysis, Springer-Verlag, New York, 2016., drugo izdanje	2	e-learning

Supplementary literature

R. Larson, B. Edwards, Calculus, Cengage Learning, 2016., 11. izdanje
J. Stewart, D. Clagg, S. Watson, Calculus, Early Transcendetals, Cengage Learning, 2021., 8. izdanje

	V. Matijević, Matematička analiza 1 i 2, skripta PMF -a u Splitu, 2020.
Quality assurance	During the semester, anonymous surveys will be administered to students to determine which concepts have been least understood thus far, which will help instructors to adapt the course. Statistics of exam results and student evaluation through anonymous questionnaires at the end of the course. The survey will be conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">DIFFERENTIAL AND INTEGRAL CALCULUS II</td></tr>
<tr><td>ID</td><td>PMM156</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Snježana Braić</td><td>Points value (ECTS)</td><td colspan="4">9.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>60</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Students will:

- acquire a basic knowledge of n-dimensional Euclidean space Rn

- acquire a knowledge about convergence of sequences in Euclidian space Rn

- learn the definition of limit and continuity of real function of several real variables, (so-called scalar function) and vector functions

- be introduced to concepts of partial derivative and directional derivative along a given vector, derivability and differentiability of scalar and vector functions

- relate differentiability of scalar function of several variables with its partial derivatives and directional derivatives along a given vector

- acquire knowledge of tangent planes, linear, differential and quadratic forms

- learn to determine higher-order differentials of a function

- apply higher-order differentials of a function to Taylor formula

- learn basic theorems of differential calculus of functions f:Rm->Rn

- learn to examine local, constrained and global extremal values of scalar functions via its differentials and partial derivatives

- learn Riemann integral of real function of two variables over a rectangle and over a Jordan measurable set

- learn fundamental theorems of integral calculus and compute double and triple integrals using various systems in</td></tr>
</table>

	plane and space - learn to calculate volume of solids, mass and the centre of gravity of three-dimensional solids - acquire basic knowledges about multiple integrals - acquire a basic knowledge of curves
Enrolment requirements	Course enrolment: Successfully completed courses Differential and integral calculus I, Introduction to math. Analysis and Linear algebra I
Learning outcomes	Upon successful completion of this course students will be able to: -describe metric and vector structure of n-dimensional Euclidean space -determine limit and accumulation points of sequences in Euclidean space -characterize basic notions of mathematical analysis via sequence convergence -compute limit point of given scalar or vector functions -examine (continuous) differentiability of vector and scalar functions of several variables - compute partial derivatives and examine derivability and differentiability of scalar functions - state, prove and apply theorems of differential calculus for scalar functions - define linear, differential and quadratic forms and calculate local, constrained and global extrema for functions of two variables - define Riemann integral of real function of two variables over a rectangle and J-measurable sets - state, prove and apply theorems of integral calculus for scalar functions - compute double and triple integrals and apply them when calculating volume, mass and the centre of gravity of the solid body - define the curve

Syllabus	– Scalar product, norm and metric on Euclidean space Rn (3) – Sequence in Rn (3) – Limit of scalar and vector function (3) – Continuity of scalar and vector function (3) – Partial derivative and directional derivatives along a given vector, linear and differential form (4) – Basic theorems of differential calculus (Schwarz' theorem, Mean value theorem, Theorem of implicit function) (4) – Differentiability of functions, Tangent plane (4) – Taylor's theorem for multivariate functions (1) – Local, constrained and global extrema for functions of several real variables (3) – Riemann integral of real functions of two variables over a rectangular (2) – Jordan measurable sets, sets of measure zero (2) – Lebesgue's criterion for Riemann integrability (2) – Basic theorems of integral calculus (Mean value theorem for integrals, Fubini's theorem, The change of variable theorem) (4) – Multiple integrals (2) – Curve (4)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Attending classes. Students are expected to be present at least 70% of classes.

Monitoring student work	Class attendance	3	Research		Practical work	

	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	3	Oral exam	3		
	Written exam		Project			

Assessment and evaluation of student work	Two partial written exams or one final written exam and final oral exam are required. There are two partial written exams during a semester. Passing both partial exams or the final written exam enables students to take an oral exam. Once they successfully pass written exam, they are not obligated to take it again no matter of the issue of the oral exam. Final grade is derived as the arithmetic mean of scores in partial exams (or a written exam) and the oral exam.		
Required literature	Title	Number of copies available	Availability on other medium
	S. Braić, Diferencijalni i integralni račun II, skripta PMF, Split		
	N.Koceić Bilan, Osnove matematičke analize I, PMF, Split		
	Š. Ungar, Matematička analiza u Rn, Tehnička knjiga, Zagreb, 2003.		
Supplementary literature	N. Uglešić, Matematička analiza II, Matematička anliza III, W. Rudin, Principles of Mathematical Analysis, Mc-Graw Hill, New York, 1964.		
Quality assurance	Summarizing test results and conducting an anonymous student survey at the end of the course. The survey is conducted according to the rules of the University of Split.		
Other (in the opinion of the proponent)			

Subject name	Dynamics of Atoms in Gases and Liquids					
ID	PMP270	Study year	1.			
Lecturer	izv. prof. dr. sc. Bernarda Lovrinčević	Points value (ECTS)	6.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			30	30	0	0
Subject status	Compulsory	Online percentage	0%			
Subject description						
Subject goals	Basic understanding of the microscopic structure and dynamics of gaseous and liquid systems and their modeling using Monte Carlo and Molecular Dynamics simulations.					
Enrolment requirements	They are equal to the conditions for accessing the qualification.					
Learning outcomes	1. Basic understanding of the microscopic structure and dynamics of liquids according to the ideas of statistical fluid physics. 2. Knowledge of basic and some of the advanced algorithms for calculating structural and thermodynamic quantities 3. Ability to model molecular systems in gaseous and liquid state 4. Ability to develop simple computer programs for simulation and analysis of simulation results 5. Understanding of computer experiments 6. Ability to use software packages for molecular dynamics simulation and data visualization programs					
Syllabus	1. Introduction to the course: basics of computer simulations, theory-experiment relationship. Basics of working in Linux. 2. Statistical description of the system: ensembles, probability density in phase space, time averaging and averaging over ensemble, ergot hypothesis. 3. N-particle density and N-particle distribution functions, 2-particle distribution function, radial distribution function (RDF), virial equation. 4. Introduction to simulations of molecular dynamics: three steps of simulation (initiation, equilibration, production). Example: molecular dynamics of rigid spheres. 5. Maxwell-Boltzmann velocity distribution in a system of rigid spheres. Code development and analysis of results. 6. Dynamic quantities in molecular dynamics: velocity-velocity correlation, diffusion coefficient: Green-Kubo and Einstein derivative. 7. Velocity autocorrelation function: code generation and analysis of results. 8. Introduction to Monte Carlo simulations: an example of the Lennard-Jones system. Use of program code and analysis of results. 9. Monte Carlo simulation of fluid with modified potential: analysis of results and comparison with Lennard-Jones fluid. 10. Molecular dynamics of Lennard-Jones fluids and analysis of program code results.					

<table>
<tr><td></td><td>11. Basic integration algorithms in molecular dynamics: calculation of particle positions and velocities.
12. Force fields in molecular dynamics: intramolecular and intermolecular potentials.
13. Basics of using a software package for molecular dynamics simulations.
14. Simulations of simple systems – water in liquid state. Results analysis and visualization.
15. Simulations of complex systems – protein in water. Results analysis and visualization.</td></tr>
<tr><td>Teaching types</td><td><table><tr><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☑ Individual assignments
☑ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☑ Domaće zadaće
☐
☐
☐</td></tr></table></td></tr>
<tr><td>Student obligations</td><td>1. Attendance and commitment of students in class and preparation of assignments in class.
2. Doing homework.
3. Preparation of a seminar paper that includes independent modeling and simulation by the method of molecular dynamics of the selected physical problem and analysis of results.
4. Writing reports and seminar presentations.</td></tr>
<tr><td>Monitoring student work</td><td><table>
<tr><td>Class attendance</td><td>1.5</td><td>Research</td><td>0.5</td><td>Practical work</td><td>1</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td>Domaće zadaće</td><td>1</td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>1</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>1</td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Assessment and evaluation of student work</td><td>1. Oral part: 2 partial exams or 1 full exam.
2. Written part: Seminar essay.</td></tr>
<tr><td>Required literature</td><td><table>
<tr><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td>B. Lovrinčević, Dinamika atoma u plinovima i tekućinama, skripta, 2021.</td><td></td><td>e-learning</td></tr>
</table></td></tr>
<tr><td>Supplementary literature</td><td>[1] J.-P. Hansen and I. R. McDonald, Theory of simple liquids, Academic Press, 2006.
[2] P. Allen & D. Tildesley, Computer Simulation of Liquids, Clarendon, Press, Oxford, 1987.</td></tr>
<tr><td>Quality assurance</td><td>1. Teachers, who have subjects with correlated learning outcomes,
cooperate and jointly take care of the quality of teaching.
2. Statistics of test results and evaluation of performance in accordance
with stated learning outcomes.
3. Student evaluation through an anonymous survey that</td></tr>
</table>

	conducted according to the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Diophantine equation</td></tr>
<tr><td>ID</td><td>PMM810</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Marija Bliznac Trebješanin</td><td>Points value (ECTS)</td><td>5.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 30
S: 15
E: 0
P: 0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>0%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">The aim of the course is to acquaint students with the fundamental knowledge of the theory of Diophantine equations, and train them for the application of that knowledge in solving various tasks. Students should adopt a variety of techniques for solving Diophantine equations.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Requirements: Course passed: Introduction to Number Theory.
Required competences: knowledge of different mathematical structures.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">The student is able to:
– define Diophantine equations
– explain various problems which are reduced to Diophantine equations
– apply different ways of solving Diophantine equations
– analyze various types of Diophantine equations</td></tr>
<tr><td>Syllabus</td><td colspan="3">–Diophantine equation (2)
– Examples of Diophantine equation (2)
–Fermats equation (2) –Linear Diophantine equation 2)
–Pells equation (2)–Group of units of quadratic integers (2)
–Binary quadratic form (2)
–Pythagorean triples. (2)
– Equation x4+y4=z2. (2)
–Sums of two squares (2)
– Sums of four squares (2)
–Ternary quadratic form (2)
–Lagrange theorem. (2)
–Thue equation (2)
– Equation y2=x3+k (2)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory</td><td>☐
☐
☐
☐</td></tr>
</table>

	☐ Combined online		☐ Mentoring			
Student obligations	Attending classesandwriting seminar paper					
Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	1		
	Colloquiums		Oral exam	3		
	Written exam		Project			
Assessment and evaluation of student work	Seminar paper and final oral exam					
Required literature	Title				Number of copies available	Availability on other medium
	Andrej Dujella, Diofantske jednadžbe, Zagreb 2006, skript					
Supplementary literature	1.I. Niven, H.S. Zuckerman, H.L. Montgomery, An Introduction to the Theory Numbers, Wiley, New York, 1991. 2.K. Ireland, M. Rosen, A classical introduction to modern number theory, Springer, New York 1982. 3.W. Sierpinski, Elementary Theory of Numbers, Panstwowe wydawnictvo naukowe, Warszawa 1964.					
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.					
Other (in the opinion of the proponent)						

Subject name	Diploma Thesis		
ID	PMPMSC	Study year	2.
Lecturer		Points value (ECTS)	30.0
Associates		Class execution (number of hours in semester)	L: 0, S: 10, E: 0, P: 0
Subject status	Compulsory	Online percentage	0%

Subject description	
Subject goals	Developing the competence of scientific research or synthesis of the selected topic in physics. Developing the competence of using relevant literature and exploring the selected topic. Developing the competence of thesis preparation and scientific/professional reporting. Preparing the original thesis, whose methodology and scientific contribution are suitable for establishing the student`s work competence and research in physics, under the direct supervision of the selected supervisor.
Enrolment requirements	The thesis is a compulsory course for every second-year graduate student.
Learning outcomes	1. Select and analyze a modern physical problem that is not included in the standard graduate program. 2. Formulate goals, tasks and research questions relevant to the problem. 3. Know the authoritative sources of knowledge. 4. Research and analyze the scientific literature and place your own research in the context of already published results, with the ultimate goal of publishing the work in a professional or scientific journal. 5. Use experimental, theoretical or computational methods to investigate a physical problem and collect data. 6. Use computer programs and appropriate models for data analysis. 7. Present the problem, its analysis of the results and conclusions in the form of an oral presentation and in the form of a text, in the form of a professional or scientific paper. 8. Edit the text stylistically by applying the spelling and grammar rules of the standard language in spoken and written communication. 9. Use multiple presentation of data and concepts (tables, graphs of functions, charts, diagrams, drawings, photographs, schemes, pictures) and correctly cite the literature. 10. Create a correct, linguistically and terminologically coherent and consistent original diploma thesis, in accordance with the standards of the profession, in which the research results of the chosen problem are presented clearly and precisely.
Syllabus	1. Research methodology. 2. Relevant bases and knowledge resources. 3. Exploration of literature. 4. Formation of the research topic and hypotheses. 5. Instruments and the design of the experiment. 6. Sampling and collection of data.

<table>
<tr><td></td><td colspan="6">7. Analysis of the results.
8. Elements of written professional and scientific reports.
9. Presentation elements.
10. Presentation-related multimedia.
The student selects one of the provided topics in physics and analyses it under the supervision of his/her supervisor with the aim to prepare a graduate thesis. After the student has passed all of the prescribed exams at the graduate study programme, he/she may, upon the agreement with the supervisor, commence with the preparation of the graduate thesis (exploration of the relevant literature, formation of the main issue/hypothesis, execution of research, analysis of research results). After the supervisor has determined that the student had sufficiently covered and mastered the selected topic, the supervisor proposes two other members of the Panel and, upon the agreement with the student, schedules the date of the graduate thesis defence at least one week before the proposed date. The student presents the graduate thesis and the fundamental knowledge in physics before a panel composed of his/her supervisor and two other teachers.</td></tr>
<tr><td>Teaching types</td><td colspan="2">☐ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☑ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Consultations with a mentor on a given topic, preparation of a thesis, planning and holding seminars and defending the thesis.
Creation of a diploma thesis.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td>30</td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">The written thesis, the public presentation of the thesis topic, and the answers to questions related to the thesis topic and physics in general are evaluated.</td></tr>
<tr><td rowspan="2">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Literature for the selected topic of the diploma thesis, as recommended by the mentor.</td><td></td><td>yes</td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Articles from the current contents of the selected topic.</td></tr>
</table>

Quality assurance	1. Interviews with the student pre- and post-graduation. 2. Student surveys.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Ecology I</td></tr>
<tr><td>ID</td><td>PMB506</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Mate Šantić</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Understand relationship between organisms and environment that is necessary to explain life process at the Earth as well as evolution of life and diversity of Earth life in time and space. Students will be obtain theoretical knowledge from fundamental ecology principles that is necessary precondition for correctly management of natural resources on the Earth.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Ability application of elementary knowledge from biology, chemistry and physics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Understand various problems in Ecology Science.
Understand basic principles between organisms (plant and animal) and environment.
Ability to distinguish ecology properties of marine and land ecosystems. Understand adaptation of organism for specific condition in environment. Understand concept of ecosystem.
Understand flow of energy and circulation of materials</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lecture 1. The nature of ecology.
Definition of ecology, ecology hierarchy, ecology divide.
Lecture 2. Life and environment, ecology factors
Explanation relationships between living (plant and animal) and not living world. Ecology factors. Ecology range (valence) of various ecology factors.
Lecture 3. Life on land (terrestrial environment)
Properties of land habitat. Dominant ecology factors. Abundancy of organisms.
Lecture 4. Life in aquatic environment.
Properties of freshwaters. Dominant ecology factors in freshwaters ecosystems. Life and adaption of organisms in freshwaters habitat (lake, river)
Lecture 5. Marine environments.
Properties of marine waters. Dominant ecology factors in marine ecosystems. Life and adaption of organisms in marine habitat.
Lecture 6. Environment condition and Adaptation of organisms. Autecology. Influence of various environmental physical-chemistry factors. Morphology convergence. Parallel evolution. Adaptive radiation.
Lecture 7. Bioclimatic rules - Bergman, Alenn and Gloger bioclimatic rules. Temperature influence on adaptation of organisms in various environment.
Lecture 8. Adaptation of organisms connect with other ecological factors (light, water, oxygen, salt, pressure, pH).</td></tr>
</table>

	Reaction of organisms connect with light, photoperiod, light and feeding, water regulation on marine and freshwater environment. Salinity influence. Influence of oxygen and pressure. Lecture 9. Biological factors in environment (1). Mutualism and commensalism Lecture 10. Biological factors in environment (2). Predation. Prey and predator adaptation, competition, amensalism and parasitism. Lecture 11. Concept of ecosystem. Trophic level in ecosystem. History development of ecology concept. Pyramids of numbers, biomass, and energy. Thermodynamic lows. Terrestrial and marine food chain. Lecture 12. Production and energy flow in ecosystem (1). Primary and secondary production. Ecosystem metabolism. Primary production in terrestrial and aquatic ecosystem. Lecture 13. Production and energy flow in ecosystem (2). Energy transformation. Energy flow in ecosystem, energy efficiency. 14. Biogeochemical cycles. Biogeochemical cycle of carbon, water, oxygen, and nitrogen and phosphate. 15. Regeneration of minerals. Biomes. Regeneration of minerals in terrestrial and aquatic ecosystem. Vertical moving of minerals in marine and freshwater ecosystems. Biomes on Earth. Seminars: During the semester keep 5 seminars. Some of that is permanency and some of that choice student considering actual occurrence in ecology and protect of environment. Permanency seminars Seminar 1: Influence of physical and chemical parameters on life in biosphere. Seminar 2: Organic production in marine and terrestrial ecosystem.

Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations			

Monitoring student work	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums	1	Oral exam			
	Written exam	2	Project			

Assessment and evaluation of student work	Do konačne ocjene dolazi se skupljanjem bodova na pismenim ispitima tijekom semestra. Maksimalni broj bodova koji se može sakupiti je 30.

	Bodovi se skupljaju kroz pismene testove na sljedeći način: Test iz poglavlja UVOD 10 bodova Test iz poglavlja EKOLOGIJA JEDINKE 10 bodova Test iz poglavlja EKOLOGIJA EKOSISTEMA 10 bodova UKUPNO 30 bodova Broj sakupljenih bodova pretvara se u jednu od ocjena prema sljedećem obrascu: > 27 bodova – izvrstan (5) 24 – 27 bodova – vrlo dobar (4) 19 – 23 boda – dobar (3) 15 – 18 bodova – dovoljan (2) < 15 bodova – student nije zadovoljio Student na kraju semestra ima pravo ponoviti jedan test po svom odabiru. Nakon ponovljenog testa postignuti bodovi su važeći, a stari bodovi iz prvog pokušaja se brišu. Studenti koji ukupno sakupe manje od 15 bodova moraju ponovo izaći na ispit iz cijelog gradiva (onoliko puta koliko to pravilnik o studiranju dozvoljava) na kojem za prolaz moraju ostvariti više od 50% mogućih bodova i u indeks im se upisuje ocjena dovoljan (2). Ukoliko je student ostvario preko 80% od mogućih bodova u indeks mu se upisuje ocjena dobar (3).		
Required literature	Title	Number of copies available	Availability on other medium
	Šolić, M: Osnove ekologije, CD s nastavnim materijalima koji uključuje PP prezentacije, skripta, DA pitanja za samoprovjeru znanja, primjere testova, te primjeri zadataka s rješenjima		da
	Šolić, M. 2016. Ekologija zajednica i ekosustava. Golden marketing - Tehnička knjiga, Zagreb (u tisku)		http://www.gmtk.hr/web/index.asp?str=51270
	Šolić, M. 2016. Krojenje života. Izvori, Zagreb (u tisku)		www.izvori.com
Supplementary literature	1. Ricklefs, R.E. and Miller, G.L. 1999. Ecology. (4. Ed.) W.H. Freeman and Company. 896 pp. 2. Begon, M., Townsend, C.R. and Harper, J.L. 2005. Ecology: From Individuals to Ecosystems. (4. Ed.), Wiley-Blackwell. 752 pp.		

	3. Krebs, C.J. 2009. Ecology: The Experimental Analysis of Distribution and Abundance. 2000. (6. Ed.). Benjamin Cummings. 655 pp.
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

Subject name	Ecology of Subterranean Habitats		
ID	PPB265	Study year	1.
Lecturer	prof. dr. sc. Biljana Apostolska	Points value (ECTS)	2.0
Associates		Class execution (number of hours in semester)	L: 15, S: 15, E: 0, P: 0
Subject status	Elective	Online percentage	10%
Subject description			
Subject goals	To know the main types of underground habitats together with abiotic and biotic parameters and understand and recognise the endemic and relict species. The special accent is on the regulative for the protection in Croatia.		
Enrolment requirements	There are no entry competencies		
Learning outcomes	Students will be able to: 1. to recognise the main types of underground habitats 2. to recognise the main karst biotopes 3. to explain abiotic and biotic parameters and their influence on biota of underground biotopes 4. to know endemic and relict species 5. to understand the regulative in protection of the Dinaric Karst		
Syllabus	Lectures/Seminars: 1. Dinaric karst and distribution in Croatia and arround the world – 2 hours + 2 hours of seminar work 2. The main types of karstic biotopes – 2 hours + 2 hours of seminar work 3. Abiotic and biotic parameters – 2 hours + 2 hours of seminar work 4. The division of the underground habitats in a groups – 2 hours + 2 hours of seminar work 5. The underground fauna – 2 hours + 2 hours of seminar work 6. Endemic and relict species – 2 hours + 2 hours of seminar work 7. Speleology and biospeleology – 2 hours + 2 hours of seminar work 8. Protection – 1 hour + 1 hour of seminar work		
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	To participate in full		

Monitoring student work						
	Class attendance		Research		Practical work	
	Experimental work		Paper			

	Essay		Seminar paper	1.0		
	Colloquiums		Oral exam	1.0		
	Written exam		Project			
Assessment and evaluation of student work	Oral exam and seminar work.					

Required literature	Title	Number of copies available	Availability on other medium
	David C. Culver and Tanja Pipan (2009): The Biology of Caves and Other Subterranean Habitats (Biology of Habitats Series)		
	David C. Culver and Tanja Pipan (2014): Shallow Subterranean Habitats: Ecology, Evolution, and Conservation		
	John Gunn (2003) Encyclopedia of Caves and Karst		
	William B. White and David C. Culver (2012) Encyclopedia of Caves, Second		
	Crvene knjige Republike Hrvatske , Državni Zavod za zaštitu		
	Priručnik za određivanje podzemnih staništa u Hrvatskoj prema Direktivi o staništima EU, Državni Zavod za zaštitu prirode		

Supplementary literature	– znanstveni i stručni radovi te ostali podaci dostupni online
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

Subject name	Experimental Methods of Modern Physics		
ID	PMP122	Study year	1.
Lecturer	prof. dr. sc. Ante Bilušić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 30, S: 15, E: 15, P: 0
Subject status	Compulsory	Online percentage	0%
Subject description			
Subject goals	Understanding the theoretical background of the selected experimental methods. Independent work on selected experimental devices and processing of the results obtained. Analysis of experimental methods from the scientific literature.		
Enrolment requirements	They are equal to the conditions for access to qualification.		
Learning outcomes	1. to know the theoretical principles, the working principle and the qualitative analysis of the results of at least five experimental methods used in scientific research. 2. to carry out practical work with at least three experimental methods from two branches of physics used in scientific research, applying the principles of laboratory work in relevant laboratories. 3. to interpret the experimental results of the methods from the previous point quantitatively and qualitatively and recognize and analyze measurement errors. 4. to use at least one computer program for the quantitative processing of test results. 5. to analyze articles from scientific journals whose topic is related to experimental methods (e.g. Review of Scientific Instruments).		
Syllabus	Lectures: spectroscopic methods: light sources, optical spectroscopy (6 hours), nuclear magnetic resonance (4 hours), X-ray and diffractometry by gamma-rays and neutrons (4 hours), Microscopy:		

	electron microscopy (2 sata) scanning tunnelling microscopy, atomic force microscopy (2 hours) vacuum techniques (1 hour), lithographic techniques (1 hour) cryogenics and thermometry (2 hours), measurement techniques in astronomy and astrophysics (3 hours) measurement techniques in nuclear physics (2 hours) measurement techniques in high-energy physics (3 hours) Seminars: Student seminar presentations of works from scientific journals. Laboratory: Independent work on the following experimental methods with introductory lectures: scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS), atomic force microscopy (AFM), dynamic light scattering (DLS), UV-Vis spectroscopy X-ray diffraction on powder sample (e.g., iron) In methods a) - d) measurements are conducted on same samples (e.g., silver and/or gold nanoparticles). Students must write a seminar paper with a description of the methods used and a presentation of the results obtained.					
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations	Independent work on experimental equipment, analysis of the results obtained and writing of reports. Preparation of a seminar paper. Participation in class					
Monitoring student work	Class attendance	1.5	Research		Practical work	

	Experimental work	1	Paper	1		
	Essay		Seminar paper	1		
	Colloquiums		Oral exam	1.5		
	Written exam		Project			

Assessment and evaluation of student work	The students take the material from the lectures in an oral examination. The prerequisite for taking the oral examination is a positively graded paper on experimental work on selected experimental equipment.		
Required literature	Title	Number of copies available	Availability on other medium
	Ante Bilušić, Lucija Krce, interna skripta		slobodan pristup
Supplementary literature	[1] M. Furić, Moderne eksperimentalne metode, tehnike i mjerenja u fizici, Školska knjiga, Zagreb, 1992. [2] R. A. Dunlap, Experimental Physics – Modern Methods, Oxford University Press, New York, 1988.		
Quality assurance	Teachers who have subjects with correlated learning outcomes cooperate and work together to ensure the quality of teaching. Statistics of examination results and assessment of performance in accordance with the defined learning outcomes. Evaluation of students through an anonymous survey conducted in accordance with College of Split regulations.		
Other (in the opinion of the proponent)			

Subject name	Electricity and Magnetism						
ID	PMP003	Study year	1.				
Lecturer	doc. dr. sc. Lucija Krce	Points value (ECTS)	9.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			60	15	30	0	
Subject status	Compulsory	Online percentage	20%				
Subject description							
Subject goals	Understanding the basics of electrodynamics.						
Enrolment requirements	Prior knowledge of elementary mathematics which was confirmed at the state graduation exam in mathematics, A-level.						
Learning outcomes	1. Develop a simple physical model applicable to solving a given problem in the field of electromagnetism. 2. Formulate mathematically a given physical model from the field of electromagnetism, and solve and evaluate numerical problems for known systems from the field of electromagnetism. 3. Demonstrate knowledge of the basic principles of electrostatics and Coulomb's law, as well as Gauss's law and its application. 4. Demonstrate knowledge of Kirchhoff's rules for circuits and their application. 5. Qualitatively and quantitatively describe and connect the electric and magnetic field of charges in motion. 6. Apply knowledge of the basic principles of magnetostatics, Biot-Savart's and Ampere's laws, and Faraday's law of electromagnetic induction. 7. Qualitatively describe and compare the magnetic properties of materials (dia-, para- and ferro-magnetism). 8. Define and distinguish the basic terms and laws related to the concept of alternating current, and apply the methods of rotating vectors and complex numbers when solving problems related to alternating current circuits. 9. Demonstrate knowledge of Maxwell's equations and electromagnetic waves in a vacuum.						
Syllabus	Seminars (1 h) and exercises (2 h) following the lectures (4 h) in units: 1. Electric charge. Coulomb's law. 2. Scalar and vector fields. Electric field. 3. Nabla operator. Gauss and Stokes theorem. Gauss's law in electrostatics. 4. Electric potential. Poisson's and Laplace's equation. 5. Electrical capacity and energy. 6. Electric current. Ohm's law. Kirchhoff's rules. 7. Complex circuits. 8. Electric and magnetic field of charge in motion. 9. Charge path. A conductor in a magnetic field. Applications (accelerators, Hall effect). 10. Biot-Savart and Amperé's law. Magnetic vector potential. 11. Faraday's law of electromagnetic induction. Lenz's rule.						

	12. Maxwell's equations. Electromagnetic waves. 13. Alternating currents in circuits. Method of rotating vectors. Method of complex numbers. Transformers. 14. Electric fields in substances. Dielectrics. Polarization. 15. Magnetic fields in (dia-, para- and ferro-magnetic) materials. Magnetization.
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	1. Active participation on lectures by giving critical judgment and argumentation of opinions, asking and answering questions. 2. Solve given problems from electromagnetism.

Monitoring student work

Class attendance	3.5	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper	0.5		
Colloquiums		Oral exam	2.5		
Written exam	2.5	Project			

Assessment and evaluation of student work	The final grade is formed after the student passes both test parts: written exam (problem solving, 50% rating) and oral exam (theory, 50% rating). During classes, short tests of learning outcomes are carried out, through which it is possible to be exempted from part of the exam, and colloquia (problems tasks) which are equivalent to the written exams.

Required literature

Title	Number of copies available	Availability on other medium
E. M. Purcell (translated by Ksenofont Ilakovac): Elektricitet i magnetizam, Berkeley Course, Tehnička knjiga, Zagreb,1988.	14	yes
Halliday, Resnick, Walker: Fundamentals of Physics, John Wiley & Sons, different editions.	21	yes
R. P. Feynman, R. B. Leighton, M. Sands, The Feynman Lectures on Physics, vol. II, Addison-Wesley, 1978. URL: https://www.feynmanlectures.caltech.edu	2	yes
E. Babić, R. Krsnik i M. Očko: Zbirka riješenih zadataka iz fizike, Školska knjiga, Zagreb 2004.	12	no

Supplementary literature	[1] Lecture notes, PMFST.

	[2] I. E. Irodov: Problems in General Physics, Roorkee: CL Media.
Quality assurance	1. Lecturers who teach subjects, which have correlated learning outcomes, collaborate and take care of teaching quality.
	2. Statistics of exam results and evaluation of efficacy in accordance with the learning outcomes. 3. Student evaluation by anonymous survey conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Electrodynamics</td></tr>
<tr><td>ID</td><td>PMP118</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Damir Kovačić</td><td>Points value (ECTS)</td><td colspan="4">8.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>15</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Upoznati studente s osnovama klasične elektrodinamike.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Nema</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Objasniti svojstva električnog naboja
2. Objasniti osnovne zakone elektrostatike; Coulombov i Gaussov zakon; Laplaceovu i Poissonovu jednadžbe
3. Objasniti metodu zrcalnih naboja i Greenovu funkciju
4. Objasniti sferne harmonike i multipolni red
5. Objasniti osnovne zakone magnetostatike; Faradayev zakon i Maxwellove jednadžbe
6. Objasniti valnu jednadžbu i svojstva elektromagnetskih valova
7. Objasniti koncepte energije, impulsa i angularnog momenta elektromagnetskog polja</td></tr>
<tr><td>Syllabus</td><td colspan="6">Električni naboj – svojstva i raspodjele. Diracova δ-funkcija. Gustoća naboja i struja.
Elektrostatika – električna sila, električno polje i skalarni potencijal. Gaussov zakon.
Maxwellove jednadžbe za elektrostatiku. Poissonova jednadžba. Rubni uvjeti – Dirichletovi, Neumannovi i mješoviti. Grenova funkcija za Poissonovu jednadžbu.
Zrcalni naboji. Sfera/kugla i točkasti naboj. Laplaceova jednadžba u Cartesian i sfernim koordinatama. Sferni harmonici.
Dielektrici. Energija električnog polja.
Razvoj potencijala u multipolni red. Multipolni momenti.
Električna struja. Magnetostatika. Biot.Savartov zakon.
Faradayev zakon indukcije. Energija magnetskog polja. Feromagneti.
Maxwellove jednadžbe.
Elektromagnetski potencijali. Gauge transformacije i gauge simetrija elektrodinamike.
Valna jednadžba i njena Greenova funkcija.
Linearni materijali.
Poyntingov teorem. Energija, impuls i angularni moment EM polja.
Elektromagnetski valovi i njihova svojstva. Zakoni geometrijske optike. Disperzija i disipacija.
Emisija EM valova. Zračenje dipola.</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures</td><td colspan="4">☐ Fieldwork</td><td></td></tr>
</table>

	[x] Seminars [x] Exercises [ ] Fully online [ ] Combined online		[ ] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring		[ ] [ ] [ ] [ ]
Student obligations	Pohađanje predavanja, seminara i vježbi. Za stjecanje prava na potpis student treba nazočiti na najmanje 50% predavanja i vježbi.				
Monitoring student work	Class attendance	3	Research		Practical work
	Experimental work		Paper		
	Essay		Seminar paper		
	Colloquiums		Oral exam	3	
	Written exam	2	Project		
Assessment and evaluation of student work	U konačnu ocjenu ulazi: 1. Pismeni ispit (ili kolokviji) – 40% ocjene, 2. Usmeni ispit – 60 % ocjene. Za prolaz pismenog ispita potrebno je riješiti najmanje 50% zadataka. Student se može osloboditi pismenog ispita preko dva kolokvija. Na oba kolokvija potrebno je riješiti najmanje 50% zadataka				
Required literature	Title	Number of copies available	Availability on other medium		
	[1] Griffiths, David J., Introduction to Electrodynamics (Prentice Hall, New Jersey, 1999)	1	Online		
	[2] Jackson, David J., Classical Electrodynamics (John Wiley and Sons, New Jersey 1998)	3	Online		
Supplementary literature	I. Supek, Teorijska fizika i struktura materije				
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split				
Other (in the opinion of the proponent)					

<table>
<tr><td>Subject name</td><td colspan="6">Elementary geometry</td></tr>
<tr><td>ID</td><td>PMM019</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Jurica Perić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The aim of the course is to systematise, consolidate and deepen the knowledge of elementary (Euclidean) geometry setting the foundation strictly axiomatic. Within this axiomatisation classic model of Euclidean geometry will be processed and introduction for other models and geometry will be made.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">/</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">The student is able to:
– list the axioms of planimetry and stereometry
– describe the history of the study of Euclid's fifth postulate
– list isometries of the plane, express and reproduce their basic properties
– describe triangle, circle and square and reproduce basic theorems, define a polygon and polygon area, show the areas of the basic polygons
– define the volume of polyhedrons and show volumes of the basic polyhedrons
– express and prove the claims of stereometry using previously proven claims from planimetry
– solve the task corresponding to the theoretical concepts worked during the course
– explain the significence of Euclidean geometry in mathematics, its historical and intuitive importance, and the reasons for the occurance of other geometries, primarily hyperbolic geometry</td></tr>
<tr><td>Syllabus</td><td colspan="6">Planimetry:
– five groups of axioms – 2 hours
– some properties of isometry, symmetries – 4 hours
– angles and some theorems about them – 2 hours
– 5. Euclidean postulate – 2 hours
– congruence of triangles, similarity of triangles – 4 hours
– circles, tendon and tangential rectangle – 4 hours

Polygons, polygon area – 6 hours
Stereometry – the geometry of space – prisms, pyramids, cylinders, cones – 3 hours – polyhedrons and volume – 3 hours</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures</td><td>☐ Fieldwork</td><td colspan="4"></td></tr>
</table>

	☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	Attendance at 70% of lectures and 70% of exercises.		

Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	1	Oral exam	3		
	Written exam	1	Project			

Assessment and evaluation of student work	The exam is taken in written and oral form. Written exam is preliminary part of the exam and requirement for the oral exam is to pass a written exam. The written form of the exam can be taken partially, during class, where curriculum provided. Activity in class, solving homework, colloquium, written and oral examination are the elements from which form the final grade is formed.

Required literature	Title	Number of copies available	Availability on other medium
	B. Pavković, D. Veljan, Elementarna matematika 1, Tehnička knjiga, Zagreb, 1991.		
	B. Pavković, D. Veljan, Elementarna matematika 2, Školska knjiga, Zagreb, 1995.		

Supplementary literature	D. Palman, Planimetrija, Element, Zagreb,1998. D. Palman, Stereometrija, Element, Zagreb, 2005.
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Energetics</td></tr>
<tr><td>ID</td><td>PMT168</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivan Peko</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Adopt basic knowledge of energetics and energy conversion and form a critical opinion about the efficient use of energy sources.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">none.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After this course, students will be able to:
- Distinguish between renewable and non-renewable energy sources.
- Describe the formation of fossil fuels
- Distinguish energy facilities.
- Describe the working principle of energy facilities.
- Compare energy conversion plants.
- Represent and defend the argument attitude about the use of certain energy sources
- Represent and provide arguments to defend position on the construction of the power plant in Croatia.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Week 1
An introductory lecture, introducing students to the rules and literature. Introduction to content of the course. Introduction to energetics, energetic concept, the concept of energy. The law of conservation of energy. Energetics, energy and power. Energy conversion. The primary and transformed energy forms.

Week 2
Entropy and the world. Energetics yesterday, today, tomorrow. History of energy use. World and energetic. Sustainable development of energetics and sustainability of energy system. Assessment methods of sustainable development of energy systems: External cost, multicriteria analysis, exergy, emergy.

Week 3
Nonrenewable energy sources. Reserves of nonrenewable energy sources. The formation of fossil fuels. Carbon. Fossil fuels: coal, oil, natural gas, nuclear energy. Estimation of non-renewable energy sources.

Week 4
Renewable energy sources, the Kyoto Protocol. European objectives. The potential of renewable energy sources. Energy water (hydropower). The energy of the sun. Wind energy. Wave energy. Tidal power and energy from the sea.</td></tr>
</table>

Biomass and biomass potential in Croatia. Biodiesel. Geothermal energy.

Week 5
Plants for converting energy. Centralized energy facilities. Centralized heating systems. Thermal power plants - power plants and diesel power plants, the thermal power station with a steam turbine, the thermal power station with gas turbine. Parts of the thermal power plant. Thermal power plants in Croatia.

Week 6
Nuclear power plants: The historical development. Principle of operation and basic division of nuclear power plants. Types of nuclear power plants. Nuclear energy compared to other energy sources. Safety of nuclear power plants. The development and goal of nuclear energy.

Week 7
1st colloquium

Week 8
Hydropower plants: Description of the plant. Division of hydropower plants. Storage hydropower plant. River hydropower plants. The pumped storage plants. Low-pressure, medium-pressure and high-pressure hydro power. Parts of hydropower plants. Types of water turbines (Pelton, Francis and Kaplan turbines). Hydroelectric power plants in Croatia.

Week 9
Solar energy. Insolation. Solar collectors. Photovoltaic cells - development, implementation and cost-effectiveness. Photo-voltage solar potential in Europe. The impact on the environment. Solar power plants.

Week 10
Wind energy. The kinetic energy of the wind. The statistics of wind, wind atlas, wind rose. Influence of terrain on the wind farm choice of location. Wind power plants. The basic division of wind power plants, main parts wind power plants. Principle of operation wind power plants. Selection of generators and mechanical systems of wind power plants. Connecting wind power plants to the electricity grid. Market of wind energy.

Week 11
The oceans as energy collectors. Methods of ocean energy conversion into electric energy: Tidal power, energy of sea waves, OTEC, other theoretical and practical technology. Tidal power: division, potential for and against. Plants for converting energy of sea waves. Ocean Thermal Energy Conversion (OTEC). Types of OTEC plants. Other technologies.

Week 12
Geothermal energy. Geothermal power plants. Types of geothermal power plants: dry steam principle (Dry steam) The principle of steam separation (flash steam), binary principle (binary cycle). Geothermal potential in Croatia.

	Week 13 Biomass. Energy from biomass. Heat pumps. The development of heat pump technology. The theoretical principle of the heat pump. Parts of heat pumps. Week 14 Croatia and world from the aspect of energetics. Energy Development Strategy in Croatian. The national program of energy development. Energetic present and future. Week 15 2nd colloquium and student paper presentations.
Teaching types	[x] Lectures [x] Seminars [ ] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [x] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring [ ] [ ] [ ] [ ]
Student obligations	Class attendance Independent planning and presentation of student paper Active participation in the teaching process Exam.

Monitoring student work	Class attendance	1.5	Research		Practical work	
	Experimental work		Paper		Self-study for exam	1.5
	Essay		Seminar paper	1		
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	Total scoring (100%): Exam or 2 colloquiums – 90%, student paper 10% 1. Colloquium 1: 45% (or exam) 2. Colloquium 2: 45% (or exam) 3. Student paper: 10% (obligatory) Rating by percentage: 50% to 62% – sufficient (2) 63% to 75% – good (3)

	76% to 88% – very good (4) 89% to 100% – excellent (5)		
Required literature	Title	Number of copies available	Availability on other medium
	B. Udovičić, Energetika, Školska Knjiga, Zagreb, 1993.		
	Energetika – predavanja – interna skripta i online materijali.		
Supplementary literature	1. V. Paar, Energetska kriza:gdje (ni)je izlaz?, Školska knjiga, Zagreb, 1984. 2. H. Požar, Osnove energetike I, II i III, Školska knjiga, Zagreb,1992. 3. P. Kulušić, Novi izvori energije, Školska knjiga, Zagreb, 1991. 4. W.E. Westman, Ecology, Impact, Assessment and Environmental Planning, J. Wiley, 1985. 5. Časopis Energija 6. Renewable Energy, edit.by Godfrey Boyle, Oxford University Press, 2004. 7. Internet		
Quality assurance	Conversation with the students. Students opinions about the quality of teaching through anonymous polls. The success of students at exam. Self-evaluation.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Energy and environment</td></tr>
<tr><td>ID</td><td>PMT175</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivan Peko</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Adopt basic knowledge of energetics with emphasis on the impact on the environment.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After this course, students will be able to:
– Represent and provide arguments to defend position on the impact of energy on the environment
– Distinguish transformation in Electric Power Systems
– Evaluate the impact of energy sector development in contribution to the environment
– Evaluate and argument the impact of climate change on energy and environment relationship
– Explain the global environmental issues
– Explain the Sustainable Energy Management</td></tr>
<tr><td>Syllabus</td><td colspan="6">Week 1
Introduction. Introducing students to the rules, literature and teaching plan. Explaining the course content. Introduction to energetics and environmental impacts.

Week 2
The law of conservation of energy states, forms of energy, primary, transformed and useful forms of energy. Sustainable energy development and evaluation of sustainable development of energy systems.

Week 3
The entropy from the world point of view. Energy yesterday, today, tomorrow. History of energy use. World and energy. Sustainable energy development and sustainability of the energy system. Methods for assessment the sustainable development of energy systems: External cost, multicriteria analysis, exergy, emergy.

Week 4
Prognosis of energy development. Projections for the development of the energy sector in the world and Croatia.

Week 5
Features of energy sources, impact on the environment, emissions in the energy and climate change</td></tr>
</table>

	Week 6 Conversions to electric power. The ability of electrical energy conservation. Week 7 Primary and transformed energy forms supply process. The share of energy in the cost of products. Waste Heat and assessment of their energy potential Week 8 1st colloquium Week 9 Climate change and the possibility of an impact on them. Week 10 Energy system development planning. Proposing measures to increase energy efficiency and selection of available technology in accordance with the defined objectives and the level of planned investment. Week 11 Energy markets Week 12 Global environmental problems Week 13 Substitution sources: renewable and non-renewable sources, availability, technical applicability, effectiveness, substitution criteria, the application of cogeneration. Examples of energy structure optimization in the energy-intensive processes (production of chemicals, paper, plastics, wood, metallurgy, etc.) Week 14 Sustainable energy management on a global scale: The Kyoto Protocol, a network of industrial energy efficiency, green and white certificates. Week 15 2nd colloquium and student paper presentations.		
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory	☐ ☐ ☐

	☐ Combined online	☐ Mentoring	☐
Student obligations	Class attendance Independent planning and presentation of student paper Active participation in the teaching process Exam.		

Monitoring student work						
	Class attendance	1	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam	0.5		
	Written exam		Project			

Assessment and evaluation of student work	Total scoring (100%): Exam or 2 colloquiums – 90%, student paper 10% 1. Colloquium 1: 45% (or exam) 2. Colloquium 2: 45% (or exam) 3. Student paper: 10% (obligatory) Rating by percentage: 50% to 62% – sufficient (2) 63% to 75% – good (3) 76% to 88% – very good (4) 89% to 100% – excellent (5)

Required literature	Title	Number of copies available	Availability on other medium
	B. Udovičić, Energetika, Školska Knjiga, Zagreb, 1993.		
	Predavanja – energetika i okoliš – online		

Supplementary literature	1. D. Foretić i ostali, Elektrane i okoliš, Element, Zagreb, 2000. 2. Renewable Energy, edited by Godfrey Boyle, Oxford University Press, 2004. 3. UNDP Environmental Governance Sourcebook, Regional Bureau for Europe, 2003 4. Internet
Quality assurance	Conversation with the students. Students opinions about the quality of teaching through anonymous polls.

	The success of students at exam. Self-evaluation.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Philosophy of Science</td></tr>
<tr><td>ID</td><td>PMP108</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Mile Dželalija</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Produbiti pojmovno razumijevanje strukture i razvoja znanstvenih teorija u povijesnom, logičkom i epistemološkom smislu, pružiti povijesnoznanstvene i filozofskologičke pretpostavke za refleksiju i kritičko preispitivanje metoda i pretpostavaka znanstvene spoznaje, poticati dijalog između prirodnih, humanističkih i društvenih znanosti.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Nema</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Na kraju kolegija studenti će moći:
– opisati osnovne elemente logičke strukture znanstvene teorije,
– izložiti glavna obilježja povijesnog razvoja znanstvene metode i znanstvenih pojmovnih okvira,
– iskazati osnovne probleme i odrediti alternativna stajališta u filozofiji znanosti,
– prepoznati vrijednost znanstvene spoznaje i argumentacije kao oblika kritičke racionalnosti u sporazumijevanju.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Sadržaj kolegija ima fleksibilnu organizaciju koja se osloncem na ključne teme prilagođava teorijskim interesima studenata.
– Odnos filozofije u znanosti u povijesnoj perspektivi. Pitanje znanstvene metode. [2 P; 2 S]
– Znanstveni jezik i spoznaja: sintaksa i semantika znanstvenog jezika i pitanje intersubjektivne provjerljivosti u logičkom empirizmu: prikaz i kritika. [1P; 1S]
– Metoda prirodne znanosti i matematika. Filozofija matematike i ontološko pitanje. Gődel i ograničenja aksiomatske metode. [2P; 2S]
– Logička teorija mjerenja. Problem mjerenja u kvantnoj fizici. [2P; 2S]
– Vrijeme, prostor, prostor-vrijeme. Položaj i razvoj teorija o prostoru i vremenu unutar empirijskih znanosti i filozofije. [2P; 2S] Ključne teorije o prostoru i vremenu (Aristotel, Newton, Leibniz, Kant, Einstein,...). [1P; 1S]
– Znanstvena spoznaja kao dinamični fenomen. Kuhnova teorija razvoja znanosti. Teorija logike promjene znanstvenih teorije. [3P; 3S]
– Realizam i antirealizam u filozofiji znanosti [1P; 1S]
– Recentni trendovi u razumijevanju odnosa znanosti i filozofije [1P; 1S]</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online</td><td>☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory</td><td colspan="4">☐
☐
☐</td></tr>
</table>

	☑ Combined online		☑ Mentoring		☐	
Student obligations	Aktivno sudjelovanje u radu kolegija. Proučavanje literature. Priprema i izlaganje seminarskog rada.					
Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam	0.5		
	Written exam		Project			
Assessment and evaluation of student work	Bilježi se redovitost pohađanje nastave. Boduje se aktivnost tijekom nastave kao te izrada i prezentacija seminarskog rada. Završni ispit obuhvaća vrednovanje završne verzije seminarskog rada i usmeni ispit.					

Required literature	Title	Number of copies available	Availability on other medium
	S. Lelas i T. Vukelja (1996) Filozofija znanosti. Zagreb: Školska knjiga.		
	Z. Šikić (1995) Filozofija matematike. Zagreb: Školska knjiga.		
	T. Kuhn (2013) Struktura znanstvenih revolucija. Zagreb: Jesenski i Turk.		

Supplementary literature	L. Wittgenstein (1987) Tractatus logico-philosophicus. Sarajevo: Veselin Masleša. B. Žarnić (2006) Filozofija znanosti: priručnik (tumačenja odabranih tekstova) http://marul.ffst.hr/~logika/2006filozofijaznanosti/skriptaFZ.pdf
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

Subject name	Financial mathematics					
ID	PMM306	Study year	2.			
Lecturer	dr. sc. Ana Perišić	Points value (ECTS)	5.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			30	0	30	0
Subject status	Elective	Online percentage	30%			
Subject description						
Subject goals	An introduction to fundamental concepts of financial mathematics required for understanding and correct interpretation of mathematical models in finance. Acquiring essential financial modelling skills through presentation of applied mathematical techniques in financial practice covered by many examples.					
Enrolment requirements	-					
Learning outcomes	Students will be able to: - explain the concept of the time value of money, - differentiate between nominal, proportional and effective interest rate, - calculate and interpret present and future values of cash flows, - construct amortization schedules for different loan repayment methods, - apply basic capital budgeting techniques, - demonstrate knowledge of modern portfolio theory, -construct the efficient frontier, - evaluating bonds, bond portfolios and evaluating options, - applying different risk assessment techniques, - carrying out basic calculations in financial mathematics in a computer-supported way,					
Syllabus	Lectures/Exercises: 1. Time value of money, simple and compound interest types of interest rates.(2h/2h) 2. Present and future values of cash flows; general annuities, perpetuities, continuous interest. (2h/2h). 3. Loan. Different loan repayment methods. Rescheduled loans. (2h/2h). 4. Intercalary interest. Effective interest. (2h/2h). 5. Capital budgeting techniques (2h/2h). 6. Bond: value, price, yield and duration. Duration of a portfolio of bonds. (2h/2h) 7. Immunization. Modeling the term structure (2h/2h). 8. Fundamental concepts of modern portfolio theory, portfolio means and variances, variance-covariance matrix. (2h/2h). 9. Efficient portfolios, efficient frontier, CAPM. (3h/3h). 10. Asset risk. Portfolio risk (2h/2h). 11. Basic option definitions and terminology. Option payoff and profit patterns, option arbitrage propositions (3h/3h).					

	12. The Binomial Option-Pricing Model (2h/2h). 13. The Black-Scholes Model (2h/2h). 14. Option Greeks (2h/2h)					
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations	Attending lectures, writing homework and writing a seminar assignment.					
Monitoring student work	Class attendance	0.1	Research		Practical work	0.5
	Experimental work		Paper			
	Essay		Seminar paper	1		
	Colloquiums		Oral exam	0.4		
	Written exam	3	Project			
Assessment and evaluation of student work	Attending lectures, writing homework, writing a seminar assignment, written and oral exam. During the semester, students have the possibility to partially take written exams through colloquia (twice during the semester). Students whopass both colloquiadon't need to take part in the writtenexam.					

Required literature	Title	Number of copies available	Availability on other medium
	Z. Babić, N. Tomić-Plazibat, Z. Aljinović, Matematika u ekonomiji, Sveučilište u Zagrebu, 2009		
	B. Šego, Z.,Lukač, Financijska matematika, Sveučilište u Zagrebu, 2011.		
	Z. Aljinović,B. Marasović, B.Šego, Financijsko modeliranje, Sveučilište u Splitu, 2011.		

Supplementary literature	J. Cvitanić, F. Zapatero, Economics and Mathematics of Financial Markets, The MIT Press, 2004 S. Benninga, Financial modeling, 3rd ed, The MIT Press, Cambridge, 2008 Šegota, A. Financijska matematika, Sveučilište u Rijeci, 2012. Babić, Z., Tomić-Plazibat, N., Poslovna matematika, Ekonomski fakultet, Split, 2004.
Quality assurance	Summarizing test results and conducting an anonymous student survey at the end of the course. The survey is conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Solid State Physics</td></tr>
<tr><td>ID</td><td>PMP201</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Željana Bonačić Lošić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">• To familiarize students with basic condensed matter physics concepts based on statistical and quantum mechanics cognitions using mainly semi-classical models.
• Comprehension of experimental occurrences in crystal structures based on microscopic physical models is expected as well as the ability to quantitatively describe and solve problems using adequate mathematical formalism.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">• quantum mechanics
• statistical mechanics
• electrodynamics</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">• To describe basic crystallographic systems, crystallographic defects and diffraction of EM waves on a crystal lattice.
• To explain characteristics of interatomic bonds in crystals and their impact on energy cohesion and macroscopic properties of solids.
• To analyze spectral functions of phonons and their contributions to internal energy, heat capacity and thermal expansion.

• To explain the gas model of free electrons and the physical quantities derived from it.
• To analyze electron energy spectrum in periodical potential and electron and electron hole properties.

• To explain transport and thermodynamic properties of metals, semiconductors and insulators.
•
• To explain dielectric properties of matter.

• To explain atomic magnetism and magnetism of matter.

• To explain occurrence and properties of superconductivity.

• To explain basic experimental techniques in physics of condensed matter.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1st week: Introduction class (introducing students and lecturers, description of work methods, student obligations and evaluations of achievements, description of the solid state physics research area, role of condensed matter physics in technology and civilization development, basic experimental methods).</td></tr>
</table>

2nd week: Crystals and crystal structures (types of crystals, crystal lattice, elementary cell, operations of symmetry, quasi-crystal, Bravais lattice).

3rd week: Crystal lattice and defects (crystal lattices, reciprocal lattice, direct and momentum space, diffraction of x rays, crystal defects, Schottky's defects, Frankel's defects, elemental excitations).

4th week: Interatomic bonds and cohesion energy (covalent bond, ionic bond, Van der Waals bond, hydrogen bond, metallic bond).

5th week: Oscillations of single-atom linear crystal lattice (wave equation, group velocity, Brillouin zone, wave number recounting).

6th week: Oscillations of two-atom linear crystal lattice (oscillations of crystal lattice with two atoms in the primitive cell, acoustic oscillations, optical oscillations)

7th week: Ionic crystals in electromagnetic field, dipole moment of the atom, polarizability of atoms and molecules.

8th week: Phonon contribution to heat capacity of crystals (acoustic and optical phonons, Debye and Einstein approximation, heat capacity of the crystal cell, Dulong-Petit rule). Heat expansion of crystal.

9th week: Sommerfeld model of metals (types of metals and their properties, Drude and Sommerfeld model of metals, Fermi energy, density of electronic states, Sommerfeld expansion, heat capacity of electron gas).

10th week: Electron in the periodic potential (Schrödinger equation for electron in the periodic potential, Bloch theorem, electron energy bands, electron hole, effective mass, van Hove singularities).

11th week: Transport phenomena (Drude model of electric conductivity, Ohm's law, Joule's heat, Matthiessen's and Nordheim's rule, phonon contribution to electrical resistance, Hall effect, Heat conductivity, Wiedemann-Franz law).

12th week: Semiconductors (types of semiconductors, zone structure of semiconductors, doped semiconductors, electron and hole conductivity of semiconductors).

13th week: Atomic magnetism (spin and orbital magnetic moment, Hund's rules, atomic paramagnetism, magnetization for J=1/2, Brillouin function, Langeven atomic diamagnetism).

14th week: Magnetic properties of matter (paramagnetism and diamagnetism of free electrons, quantum theory of ferromagnetism, magnetic domains and hysteresis, Weiss theory of molecular field, antiferromagnetism, Curie - Weiss law).

<table>
<tr><td></td><td colspan="3">15th week: Superconductivity (Meissner effect, isotopic effect, type 1 and type 2 superconductors, electron – phonon coupling, Cooper pairs, BCS theory, superconductivity gap, critical temperature, critical current, Josephson effect).</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Attendance of at least 50% of lectures and exercises.
At least 50% of solved homework problems handed in.</td></tr>
</table>

Monitoring student work						
Class attendance	2	Research		Practical work	
Experimental work		Paper		Domaće zadaće	0.5
Essay		Seminar paper			
Colloquiums		Oral exam	2		
Written exam	1.5	Project			

Assessment and evaluation of student work

Evaluation of student achievements and activities are graded as follows:
• class attendance – up to 10 points
• homework problem solving – up to 10 points
• written exam – up to 30 points
• oral exam – up to 50 points
Written exam is consisted of problems (exercises) that need to be solved. This exam can be passed during the semester via two colloquia. In order to attend the oral exam, student must solve at least 50% of problems in the written exam and must fulfill all requirements to get the professor's signature. In order for student to pass the exam via colloquia, he or she must solve at least 50% of all problems from both colloquia. Oral exam is consisted of 5 questions from different content units. These questions are randomly selected from an initially known list of question.
Grades are given according the following score ranges:
• 89 – 100 points : excellent
• 76 – 88 points: very good
• 63 – 75 points: good
• 50 – 62 points: enough

Required literature

Title	Number of copies available	Availability on other medium
C. Kittel, Introduction to Solid State Physics, 8th edition, John Wiley & Sons, Inc.,2005.	11	

	V. Šips, Uvod u fiziku čvrstog stanja, Školska knjiga Zagreb, 1991.	8	
	V. Šips, Uvod u fiziku čvrstog stanja, Školska knjiga Zagreb, 2003.	5	
Supplementary literature	G.I.Epifanov, Solid State Physics, MIR Publishers, Moscow, 1979.		
Quality assurance	• Evaluation of student achievements in accordance with expected outcomes • Lecturer's self-evaluation • Student feedback through questionnaires • In-institution and out-institution review		
Other (in the opinion of the proponent)			

Subject name	Elementary Particle Physics I						
ID	PMP20E	Study year	1.				
Lecturer	doc. dr. sc. Marko Kovač	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			45	0	15	0	
Subject status	Compulsory	Online percentage	25%				
Subject description							
Subject goals	Stjecanje osnovnih znanja i kompetencija iz fizike elementarnih čestica. Predmet objedinjuje znanja stečena u predmetima kvantne mehanike i klasične elektrodinamike u relativističko-kvantni opis međudjelovanja elementarnih čestica.						
Enrolment requirements	Stečeni ishodi učenja predmeta Klasična elektrodinamika i Kvantna fizika						
Learning outcomes	Nakon usvajanja gradiva od studenta se očekuje da zna: - klasificirati temeljne čestice i sile u prirodi te navesti mase i vremena života čestica karakteričnih za pojedine interakcije; - heuristički izvod Schrödingerove i Klein-Gordonove jednadžbe te pridružene jednadžbe kontinuiteta; - izvesti Diracovu jednadžbu linearizacijom Klein-Gordonove jednadžbe; - riješiti Diracovu jednadžbu za slobodnu česticu i demonstrirati poznavanje osnovnih svojstava Diracovih spinora; - navesti sačuvane veličine pridružene zasebnim kontinuiranim prostornovremenskim simetrijama - Noetherin teorem; - osnove Feynmanovog računa i primjenu na ABC teoriju; - osnovne koncepte kvantne elektrodinamike i kromodinamike; - osnovne koncepte slabih međudjelovanja i elektro-slabog ujedinjenja; - objasniti baždarne teorije i Higgsov mehanizam; - osnove fizika van Standardnog modela.						
Syllabus	1. Uvod u fiziku čestica: kako proizvodimo i kako detektiramo čestice, povijesni razvoj fizike elementarnih čestica, Heavyside-Lorentzov sustav jedinica. 2. Dinamika elementarnih čestica: fundamentalne sile, kvantna elektrodinamika (QED), kvantna kromodinamika (QCD), slaba međudjelovanja, zakoni sačuvanja. 3. Relativistička kinematika: Lorentzove transformacije, sudari, sustav centra mase i laboratorijski sustav. 4. Eksperimentalne metode: akceleratori, međudjelovanje čestica i materije, detektori čestica, otkriće Higgsovog bozona. 5. Simetrije: translacije, rotacije, parnost, konjugacija naboja i inverzija vremena. 6. Feynmanov račun: raspadi i raspršenja, zlatno pravilo za raspade i raspršenja, ABC teorija. 7. Osnove kvantne elektrodinamike. 8. Osnove kvantne kromodinamike. 9. Osnove slabih međudjelovanja.						

	10. Elektro-slabo ujedinjenje. 11. Baždarne teorije i Higgsov mehanizam. 12. Fizika van Standardnog modela.					
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations	Pohađati barem 70% predavanja i 70% vježbi. Rješavati domaće zadaće					
Monitoring student work	Class attendance	2	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	1	Oral exam	2		
	Written exam	1	Project			
Assessment and evaluation of student work	Položiti dva kolokvija koja se sastoje od zadataka i pitanja iz teorije s uspjehom barem 50% iz svakog kolokvija ili položiti završni ispit s uspjehom barem 50%					
Required literature	Title	Number of copies available	Availability on other medium			
	Griffiths, David. Introduction to elementary particles 2nd Edition, 2008					
	Halzen, Francis, and Alan D. Martin. Quarks and Leptons: An Introductory Course in Modern Particle Physics, Wiley, 2010.					
	Martin, B. R., & Shaw, G. (2017). Particle physics. Chichester, West Sussex, United Kingdom: John Wiley & Sons, Ltd.					
Supplementary literature	Slideovi i bilješke s predavanja					
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">Elementary Particle Physics II</td></tr>
<tr><td>ID</td><td>PMP234</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Marko Kovač</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">25%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Stjecanje znanja i kompetencija iz fizike elementarnih čestica. Predmet objedinjuje znanja stečena u kolegijima kvantne mehanike i klasične elektrodinamike u relativističko-kvantni opis međudjelovanja elementarnih čestica.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Stečeni ishodi učenja predmeta Fizika elementarnih čestica I.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Nakon usvajanja gradiva od studenta se očekuje da zna:
- napisati Maxwellove jednadžbe u kovarijantnom obliku, navesti relativistički kovarijantni Lagrangian iz kojeg se postupkom varijacije mogu izvesti Maxwellove jednadžbe i demonstrirati poznavanje odgovarajućeg izvoda;
- navesti relativistički kovarijantni Lagrangian iz kojeg se postupkom varijacije mogu izvesti Klein-Gordonova i Diracova jednadžba te demonstrirati poznavanje odgovarajućeg izvoda;
- koncepte kvantne elektrodinamike (QED) i Feynmanova pravila za QED;
- opisati procese u drugom redu računa smetnje: Møllerovo raspršenje, Bhabhaino raspršenje, Comptonovo raspršenje, produkcija/anihilacija para te anihilaciju elektrona i pozitrona u mion i antimion.
- objasniti postupak dobivanja informacija o strukturi protona;
- opisati raspade miona, nabijenih piona, kaona i teških mezona;
- teoriju elektroslabog ujedinjenja;
- osnovne koncepte fizike neutrina;
- objasniti porijeklo masa u okviru Standardnog modela;
- opisati otkriće Higgsovog bozona.</td></tr>
<tr><td>Syllabus</td><td colspan="6">13. Varijacijski princip, Lagrangian Maxwellovog i Diracovog polja, Noether struje.
14. Učestalost raspada i udarni presjeci, Lorentz invarijantni fazni prostor.
15. Kvantna elektrodinamika: Feynmanova pravila i Casimirov trik.
16. QED procesi: Moelerovo raspršenje, Bhabhaino raspršenje, Comptonovo raspršenje i produkcija/anihilacija para.
17. Ostali QED procesi: Mottovo raspršenje i anihilacija elektrona i pozitrona.
18. Kvantna kromodinamika (QCD): zatočenje kvarkova, asimptotska sloboda, Feynmanova pravila, jetovi, elastični i neelastično raspršenje elektrona.
19. Slabe interakcije: V-A teorija, raspad miona, raspad nabijenog piona, raspadi kaona, raspadi teških mezona.
20. Elektroslabo ujedinjenje.
21. Fizika neutrina: oscilacije neutrina, neutrinske mase i miješanje u leptonskom sektoru.
22. Baždarne teorije i lokalna baždarna invarijantnost.</td></tr>
</table>

	23. Porijeklo masa čestica Standardnog modela, Higgsov mehanizam u Standardnom modelu, mase baždarnih bozona, masa Higgsovog bozona. 24. Fizika van Standardnog modela.
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Pohađati barem 70% predavanja i 70% vježbi. Rješavati domaće zadaće.

Monitoring student work:

Class attendance	2	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums	1	Oral exam	2		
Written exam	1	Project			

Assessment and evaluation of student work	Položiti dva kolokvija koja se sastoje od zadataka i pitanja iz teorije s uspjehom barem 50% iz svakog kolokvija ili položiti završni ispit s uspjehom barem 50%.

Required literature:

Title	Number of copies available	Availability on other medium
Griffiths, David. Introduction to elementary particles 2nd Edition, Wiley, 2008.		
Halzen, Francis, and Alan D. Martin. Quarks and Leptons: An Introductory Course in Modern Particle Physics, Wiley, 2010.		
Martin, B. R., & Shaw, G. (2017). Particle physics. Chichester, West Sussex, United Kingdom: John Wiley & Sons, Ltd.		

Supplementary literature	Slideovi i bilješke s predavanja
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Ocean Physics I</td></tr>
<tr><td>ID</td><td>PMP163</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Žarko Kovač</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">– gaining knowledge on basic dynamical and physical processes in the ocean
– provide knowledge of equations describing the physical dynamics of the oceans
– acquiring basic knowledge about the impact of physical on biological and chemical processes in the oceans</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">– basics of physics
– basics of mathematics
– basics of fluid mechanics
– basic programming</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">– knowledge of physical processes in the sea
– knowledge of basic equations of physical oceanography
– knowledge of boundary conditions
– formulation of simple mathematical models in physical oceanography
– introductory knowledge about the effect of physical on biological processes in the ocean
– introductory knowledge of the transport of tracers by ocean currents</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Non-inertial reference frame (2 hours of lectures)
2. Coriolis force (2 hours of lectures)
3. Inertial oscillations (4 hours of lectures)
4. Equations of motion (4 hours of lectures)
5. Geostrophic balance (4 hours of lectures)
6. Continuity equation (2 hours of lectures)
7. Energy conservation equation and equation of state (4 hours of lectures)
8. Boundary conditions (2 hours of lectures)
9. Interaction of light and sea water (4 hours of lectures)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="2">☑ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td colspan="3">☑ domaće zadaće
☐
☐
☐</td></tr>
</table>

<table>
<tr><td>Student obligations</td><td colspan="6">Attend at least 70% of lectures and 70% of exercises.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td>Domaće zadaće</td><td>1</td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>2</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">During the first 7 weeks of classes, students receive 5 homework assignments from the first 5 teaching units. These assignments are handed over at the end of the 8th week of classes. During the next 7 weeks of classes, students receive 5 new homework assignments from the last 4 teaching units. These assignments are handed over at the end of the 15th week of class. Students who submit assignments on time and achieve more than 50% of the possible points are exempted from taking the written part of the exam. Students who do not pass assignments or achieve less than 50% of the possible points must take a written exam. The final grade is formed on the basis of homework / exam (1/2 grade) and the answer to the oral exam (1/2 grade).</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Benoit Cushman-Roisin & Jean-Marie Beckers Introduction to Geophysical Fluid Dynamics: Physical and Numerical Aspects Academic Press, 2007</td><td></td><td></td></tr>
<tr><td colspan="4">Robert H. Stewart Introduction To Physical Oceanography Texas A & M University, 2000</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Steven Pond & George L. Pickard
Introductory Dynamical Oceanography
Butterworth-Heinemann, 1983
George L. Pickard & William J. Emery
Descriptive Physical Oceanography: An Introduction
Pergamon Press, 1982

Lynne D. Talley, George L. Pickard, William J. Emery, James H. Swift
Descriptive Physical Oceanography: An Introduction
Academic Press, 2011</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">Ocean Physics II</td></tr>
<tr><td>ID</td><td>PMP268</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Žarko Kovač</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>5</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">– gaining knowledge on basic dynamical and physical processes in the ocean
– acquiring knowledge of physical models describing ocean currents and wave motion
– to introduce students to basic numerical methods for solving differential equations describing the physical dynamics of the ocean
– gaining knowledge about more complex forms of motion in the ocean
– to introduce students with to the concept of vorticity</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">– Ocean Physics I
– Introduction to Fluid Mechanics
– programming</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">– basic knowledge about turbulence in the ocean
– knowledge of basic forms of currents in the ocean and their physical causes
– understanding different forms of wave motion in the ocean
– introductory knowledge of numerical methods of discretization of equations of equations of motion
– basic knowledge of ocean tides</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Reynolds averaging (2 hours of lectures)
2. Turbulent cascade (2 hours of lectures)
3. Surface Ekman layer (4 hours of lectures)
4. Bottom Ekman layer (2 hours of lectures)
5. Wind currents in the oceans (6 hours of lectures)
6. Vorticity (2 hours of lectures)
7. Free waves (4 hours of lectures)
8. Shallow water equations and dynamics (4 hours of lectures)
9. Tides (2 hours of lectures)
10. Storm surge (2 hours of lectures)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises</td><td>☑ Fieldwork
☑ Individual assignments
☐ Multimedia</td><td colspan="4">☑ domaće zadaće
☐</td></tr>
</table>

	☐ Fully online ☐ Combined online		☐ Laboratory ☐ Mentoring		☐ ☐
Student obligations	Attend at least 70% of lectures and 70% of exercises.				
Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper		Domaće zadaće	1
	Essay		Seminar paper			
	Colloquiums		Oral exam	2		
	Written exam	1	Project			
Assessment and evaluation of student work	During the first 7 weeks of classes, students receive 5 homework assignments from the first 5 teaching units. These assignments are handed over at the end of the 8th work in class and at the final exam week of classes. During the next 7 weeks of classes, students receive 5 new homework assignments from the last 4 teaching units. These assignments are handed over at the end of the 15th week of class. Students who submit assignments on time and achieve more than 50% of the possible points are exempted from taking the written part of the exam. Students who do not pass assignments or achieve less than 50% of the possible points must take a written exam. The final grade is formed on the basis of homework / exam (1/2 grade) and the answer to the oral exam (1/2 grade).				
Required literature	Title	Number of copies available	Availability on other medium		
	Benoit Cushman-Roisin & Jean-Marie Beckers Introduction to Geophysical Fluid Dynamics: Physical and Numerical Aspects Academic Press, 2007		da		
Supplementary literature	Jochen Kampf Ocean Modelling for Beginners Springer, 2009. Jochen Kampf Advanced Ocean Modelling Springer, 2009. Reza Malek-Madani Physical Oceanography: A Mathematical Introduction with MATLAB CRC Press, Taylor & Francis, 2012. Rick Salmon Introduction to Ocean Waves Scripps Institution of Oceanography, 2018.				
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.				
Other (in the opinion of the proponent)					

<table>
<tr><td>Subject name</td><td colspan="3">Plant physiology</td></tr>
<tr><td>ID</td><td>PMB034</td><td>Study year</td><td>3.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Valerija Dunkić</td><td>Points value (ECTS)</td><td>8.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 45, S: 0, E: 45, P: 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>10%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3"></td></tr>
<tr><td>Enrolment requirements</td><td colspan="3"></td></tr>
<tr><td>Learning outcomes</td><td colspan="3"></td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☑ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3"></td></tr>
<tr><td>Monitoring student work</td><td colspan="3"><table>
<tr><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td>2</td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td>2</td><td>Oral exam</td><td>2</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="3"></td></tr>
<tr><td>Required literature</td><td colspan="3"><table>
<tr><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td>Pevalek-Kozlina, B. (2003) Fiziologija bilja. Sveučilišni udžbenik. Profil International, Zagreb.</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">Taiz, L. and Zeiger, E. (2002): Plant Physiology. Sinnauer Ass. Inc. Sunderland, Massachusetts.</td></tr>
</table>

	Buchanan, B., Gruissem, W., and Jones, R. L. (2002): Biochemistry and Molecular Biology of Plants. John Wiley & Sons. Stryer, L. (1991): Biokemija. Školska knjiga, Zagreb.
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="9">Fourier Analysis and Applications</td></tr>
<tr><td>ID</td><td colspan="3">PMM820</td><td colspan="2">Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td colspan="3">prof. dr. sc. Saša Krešić Jurić</td><td colspan="2">Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td colspan="3" rowspan="2"></td><td colspan="2" rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td colspan="3">Elective</td><td colspan="2">Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="10">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="9">To introduce students to the fundamentals of Fourier series, Fourier transform and applications to signal processing.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="9">The student must have passed the following courses: Introduction to mathematical analysis, Mathematical analysis I and Linear algebra. The student must have taken the course Mathematical analysis II.</td></tr>
<tr><td>Learning outcomes</td><td colspan="9">Knowledge of the fundamentals of Fourier series, computation of Fourier series and identifying different types of convergence of the series. Knowledge of basic properties of the Fourier transform and its applications to signal filtering and sampling.</td></tr>
<tr><td>Syllabus</td><td colspan="9">1.Inner product spaces: inner product, Cauchy-Schwartz inequality, orthonormal systems, convergence in the norm, basis, Bessel's inequality, Parseval's relation. +
2.Fourier series: definition and computation of Fourier series, Fourier series of even and odd functions, complex Fourier series, pointwise convergence and Dirichlet's theorem, uniform converence, convergence in the mean.
3.Fourier transform: Fourier transform in L^1(R), basic properties of the Fourier transform, Riemann-Lebesgue lemma, convolution theorem, Fourier transform in L^2(R), Plancharel identity, inverse Fourier transform.
4.Applications to signal processing: linear filters, time-invariant filters, causal filters, low-pass filters, Shannon-Whittaker sampling theorem, uncertainty principle.</td></tr>
<tr><td>Teaching types</td><td colspan="3">[x] Lectures
[ ] Seminars
[x] Exercises
[ ] Fully online
[ ] Combined online</td><td colspan="3">[ ] Fieldwork
[ ] Individual assignments
[ ] Multimedia
[ ] Laboratory
[ ] Mentoring</td><td colspan="3">[ ]
[ ]
[ ]
[ ]</td></tr>
<tr><td>Student obligations</td><td colspan="9">Class attendance and taking partial and final exams.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2</td><td colspan="2">Research</td><td></td><td colspan="3">Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td colspan="2">Paper</td><td></td><td colspan="3"></td><td></td></tr>
<tr><td>Essay</td><td></td><td colspan="2">Seminar paper</td><td></td><td colspan="3"></td><td></td></tr>
<tr><td>Colloquiums</td><td>1</td><td colspan="2">Oral exam</td><td>1</td><td colspan="3"></td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td colspan="2">Project</td><td></td><td colspan="3"></td><td></td></tr>
</table>

Assessment and evaluation of student work	Partial exams, written exam and oral exam.		
Required literature	Title	Number of copies available	Availability on other medium
	A.Pinkus, S.Zafrani, Fourier Series and Integral Transforms, Cambridge University Press, Cambridge, 1997.		
Supplementary literature	P. Bremaud, Mathematical Principles of Signal Processing: Fourier and Wavelet Analysis, Springer, New York, 2002.		
Quality assurance	Student evaluations following completion of the course. The evaluations are administered according to the regulations of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="7">Genetics and Biotechnology in agriculture</td></tr>
<tr><td>ID</td><td>PMB547</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivica Šamanić</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>10</td><td>20</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">To impart theoretical knowledge and practical skills about plant breeding objectives in Mediterranean-Climate Regions, modes of reproduction and genetic consequences, breeding methods for crop improvement.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Fundamental knowledge of cell biology and botany are required.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After successful completion of this course students will be able to:
• assess possibility of the practical application of different in vitro methods
that can be implemented to achieve the genetic variability within the
economically important plant species
• use the basic laboratory equipment necessary to maintain or grow plant
cells, tissues or organs under sterile conditions on a nutrient culture
medium
• determine the possible benefits and environmental risks of Genetically
Modified Plants (GMPs)
• write a lab report that includes an evaluation of the results obtained in the
laboratory
• present research in a seminar form</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures (30 hours)
1. Unique genetic features of plants (Ability to photosynthesize, Totipotency of plant cells, Hermaphroditism and ability to reproduce both sexually and asexually, Double fertilization, Polyploidy, Alternation of generations, Mitosis in haploid state) 2. Plant Genome Organization and Function (Three independent genomes of the plant cell; Repeated Sequences, Organization of Single-copy Sequences, Evolution of Repeated Sequences in Cereals, Chloroplast Genome Organization, Mitochondrial Genome Organization, RNA editing)
3. Regulatory Mechanisms in Plant Development (Molecular mechanisms whereby endogenous and environmental regulatory factors control development; emphasis on stimulus perception and primary events in the signal chain leading to modulated gene expression and cellular development)
4. Inheritance Patterns (Mendelian Patterns of Inheritance, Boveri and Sutton's chromosome theory of inheritance, The molecular basis of genetic dominance, Cellular and molecular basis of inheritance, Cytoplasmic inheritance, Polygenic Trait)
5. Interactions of allelic genes (Interactions between the alleles of one gene: incomplete dominance, codominance,</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">lethal alleles, multiple alleles; Interaction between alleles at different genes (loci): epistasis, pleiotropy, complementary genes, duplicate genes)
6. Disease Resistance and Abiotic Stress Tolerance (Management of plant diseases using genetic engineering: Plant disease resistance genes; Gene expression and signal transduction in response to dehydration)
7. Chromatin structure and gene expression (Hetrochromatin and euchromatin, Histone modifications, DNA methylation)
8. Principles and Techniques of Plant Breeding (The principles, methods and applications of plant breeding and genetics to the improvement of crop plants, alternative approaches through hybridization and selection)
9. Methods for Plant Genetic Modification (Use of Agrobacterium tumefaciens, Ti plasmids, Strategies for gene transfer to plant cells, Direct DNA transfer to plants, Gene targeting in plants)
10. Plant Genetic Engineering (molecular pharming, plantibodies)
11. Mapping Plant Genome with Molecular Markers (Classes of Molecular markers, detecting DNA polymorphisms, Genetics of mapping molecular loci, Comparative Genome mapping, mapping quantitative trait loci with molecular markers, application of molecular markers to Selection)
12. Fertility-Regulating Mechanisms and Their Manipulation (Male Sterility and Fertility Restoration in Crops, Molecular basis of self-incompatibility and its utilization in crop improvement)
13. Mobile genetic elements; retrotransposons and DNA transposons
14. Haploid and triploid plants (Androgenesis induction in microspore culture, Gynogenesis using ovule culture, In vitro induction of haploid, diploid and triploid plantlets)
15. Plant tissue culture (Plant micropropagation Method for in vitro Plant Regeneration, Plant Protoplast: Isolation, Culture and Fusion Techniques; Somaclonal Variation in Tissue Culture)
Exercises (20 hrs)
1. Cross pollination to generate Arabidopsis transgenic plants harboring promoter::GUS constructs
2. In vitro plant tissue culture
3. Surface seed sterilization procedures
4. DNA extraction from plant tissue
5. Applications of Polymerase Chain Reaction (PCR) to easily isolate individual plants that carry a particular T-DNA mutation of interest
6. Histochemical localization of β-glucuronidase (GUS) reporter activity in plant tissues
Seminars (10 hrs)
Reading and discussing primary scientific literature, writing a short assay summarizing analyzed articles. Selected articles related to the above topics will be analyzed in 2-hour blocks. The aim is to develop writing skills and presentation skills needed to effectively communicate the purpose, scope, and conclusions of the project.</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☑ Exercises
☐ Fully online
☑ Combined online</td><td>☐ Fieldwork
☑ Individual assignments
☑ Multimedia
☑ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td></td><td colspan="3"></td></tr>
</table>

Student obligations						
Monitoring student work	Class attendance	1.5	Research		Practical work	0.5
	Experimental work		Paper		Laboratorijski izvještaj	0.5
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam			
	Written exam	1	Project			
Assessment and evaluation of student work	Student evaluation • Lab reports All lab reports must contain complete and detailed outline of the experimental procedure, description of the results accompanied by analysis and interpretation. • Research-based class seminar will be elevated. Students will have to prepare presentation showing background of the problem they are dealing with. The presentation will be scored according to the content of the presentation (key words, critical review of literature, presentation of scientific results), format, innovativeness and language competence as well. • Class Participation will also be part of the grade. • Final Lecture Exam: written examination (multiple-choice questions from the presentation material). Final grades will be based on each student's performance as assessed by points total.					

Required literature	Title	Number of copies available	Availability on other medium
	Slater A., Scott N. W., Fowler M. R. (2008) Plant Biotechnology: the genetic manipulation of plants (second edition). Oxford University Press		
	Grotewold E., Chappell J., Kellogg E. A. (2015) Plant Genes, Genomes and Genetics. JohnWiley&Sons,Ltd.		

Supplementary literature	Jelaska, Sibila (1994). Kultura biljnih stanica i tkiva. Zagreb: Školska knjiga. Andreja Abramovič Ristov (ur) (2007). Metode u molekularnoj biologiji. Institut Ruđer Bošković. Ranabhatt, Hiru., Kapor, Renu. (2018). Plant Biotechnology. Woodhead Publishing India Pvt. Ltd. Odabrani znanstveni članci
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

Subject name	Informatics Practice		
ID	PMIK80	Study year	2.
Lecturer	prof. dr. sc. Saša Mladenović	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 0, S: 0, E: 0, P: 176
Subject status	Elective	Online percentage	0%

Subject description

Subject goals	The course goal is to prepare students for the work market. Students development are guided in accordance with the work market demand. The goal is to develop independent and creative problem-solving skills.
Enrolment requirements	In accordance to paragraph 4. subdivision 6. of the University of Split internship rulebook, if the number of available internship places is less than the number of applicants than the selection procedure will be organized in accordance with the paragraph 5. of the internship rulebook.
Learning outcomes	Use the gained knowledge to solve concrete tasks. To estimate resources needed to successfully accomplish the task. To estimate the time needed for the task completion. To solve the problem independently by using internet resources. To cooperate with other employees in the receiving firm.
Syllabus	Informatics practice (internship) is realized in the receiving firm, training base during 22 working days, 8h per day according to the time table agreed upon with the internship mentor. It can start as early as 1st October and can end as late as the end of the academic year. It is assumed that the student will be informed about the firm's nature of the business and marketplace. The task or tasks, as well as a detailed plan of activity, will be prepared in cooperation with the internship mentor.
Teaching types	☐ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring ☐ ☐ ☐ ☐
Student obligations	The realization of tasks in accordance with the activity plan prepared. Creating an internship report and presentation in front of the mentor appointed by the Faculty.

Monitoring student work						
	Class attendance		Research		Practical work	5
	Experimental work		Paper			

	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	Internship mentor grade the student by using descriptive marks: – the student has successfully accomplished the internship – the student has not accomplished the internship The last mark has to be justified in written form. When the internship mentor positively evaluated the student's internship, mentor appointed by the Faculty is analyzing the internship report, discusses with the student about working tasks and grade the student by using descriptive marks: – the student has successfully created and defended the internship report – the student has not successfully created and defended the internship report The last mark has to be justified in written form. When both mentors grade the internship as successful the overall grade is "passed successfully". In the student failed to pass it is not allowed to enroll the course again next year.

Required literature	Title	Number of copies available	Availability on other medium
	–		

Supplementary literature	
Quality assurance	The questionnaires are filled by the student in accordance with the Split University internship rulebook. The student uses the 5 levels Likert scale to evaluate the internship. Moreover, the student can make remarks and suggest changes with the goal to improve the internship for the future.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Informatics Practice</td></tr>
<tr><td>ID</td><td>PMIK80</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Saša Mladenović</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>176</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
</table>

<table>
<tr><td colspan="2">Subject description</td></tr>
<tr><td>Subject goals</td><td>The course goal is to prepare students for the work market.
Students development are guided in accordance with the work market demand.
The goal is to develop independent and creative problem-solving skills.</td></tr>
<tr><td>Enrolment requirements</td><td>In accordance to paragraph 4. subdivision 6. of the University of Split internship rulebook, if the number of available internship places is less than the number of applicants than the selection procedure will be organized in accordance with the paragraph 5. of the internship rulebook.</td></tr>
<tr><td>Learning outcomes</td><td>Use the gained knowledge to solve concrete tasks.
To estimate resources needed to successfully accomplish the task.
To estimate the time needed for the task completion.
To solve the problem independently by using internet resources.
To cooperate with other employees in the receiving firm.</td></tr>
<tr><td>Syllabus</td><td>Informatics practice (internship) is realized in the receiving firm, training base during 22 working days, 8h per day according to the time table agreed upon with the internship mentor. It can start as early as 1st October and can end as late as the end of the academic year.
It is assumed that the student will be informed about the firm's nature of the business and marketplace.
The task or tasks, as well as a detailed plan of activity, will be prepared in cooperation with the internship mentor.</td></tr>
</table>

<table>
<tr><td>Teaching types</td><td>☐ Lectures
☐ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☑ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="2">The realization of tasks in accordance with the activity plan prepared.
Creating an internship report and presentation in front of the mentor appointed by the Faculty.</td></tr>
</table>

<table>
<tr><td rowspan="3">Monitoring student work</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td>5</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	Internship mentor grade the student by using descriptive marks: – the student has successfully accomplished the internship – the student has not accomplished the internship The last mark has to be justified in written form. When the internship mentor positively evaluated the student's internship, mentor appointed by the Faculty is analyzing the internship report, discusses with the student about working tasks and grade the student by using descriptive marks: – the student has successfully created and defended the internship report – the student has not successfully created and defended the internship report The last mark has to be justified in written form. When both mentors grade the internship as successful the overall grade is "passed successfully". In the student failed to pass it is not allowed to enroll the course again next year.					
Required literature	Title	Number of copies available		Availability on other medium		
	–					
Supplementary literature						
Quality assurance	The questionnaires are filled by the student in accordance with the Split University internship rulebook. The student uses the 5 levels Likert scale to evaluate the internship. Moreover, the student can make remarks and suggest changes with the goal to improve the internship for the future.					
Other (in the opinion of the proponent)						

Subject name	Instrumental methods of analysis					
ID	PPC215	Study year	1.			
Lecturer	doc. dr. sc. Ivana Mitar	Points value (ECTS)	2.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			15	0	15	0
Subject status	Elective	Online percentage	0%			
Subject description						
Subject goals	Adopt and understand the basics principles and application of instrumental analytical methods of physico-chemical analysis.					
Enrolment requirements						
Learning outcomes	➢explain the physico-chemical fundamentals of particular method of instrumental analysis, ➢distinguish methods by types of testing ➢participate in selection of the appropriate test method according to the types of samples to be tested participate in explanation and interpretation of the results of analyzes					
Syllabus	Lectures: SPECTROSCOPIC METHODS 1.Introduction to spectroscopic methods, instruments in spectroscopy (2 lessons) 2.UV-Vis, Fluorescence spectroscopy (2 lessons) 3.IR, Raman spectroscopy (2 lessons) 4.Atomic spectroscopy, XRF (1 lesson) 5.Mass spectrometry (1 lesson) 6. NMR spectroscopy (1 lesson) CHROMATOGRAPHIC METHODS 7.Introduction to chromatographic methods, (TLC, Column chromatography) (2 lessons) 8.Liquid chromatography -HPLC (Size ex., Ion, Affinity, Supercritical) (2 lessons) 9.Gas chromatography -GC (2 lessons) Exercises: SPECTROSCOPY: 1.UV/Vis and fluorescence spectroscopy (3 lessons) 2.IR and Raman spectroscopy (3 lessons) 3.XRF spectroscopy (3 lessons) CHROMATOGRAPHY: 1.HPLC - liquid chromatography (3 lessons) 2.GC - gas chromatography (3 lessons)					

Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☐ Individual assignments ☑ Multimedia ☑ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations	Students are required to attend classes (lectures and seminars 80%, laboratory practice and field work 100%) and actively participate in the teaching process. This will be recorded and evaluated in making a final assessment.					
Monitoring student work	Class attendance	0.5	Research		Practical work	1.0
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	0.5		
	Written exam		Project			
Assessment and evaluation of student work	Grades: <50% not satisfied; 50-60% successful (2) 60-70% good (3), 70-85% very good (4), 85-100% excellent (5).					
Required literature	Title				Number of copies available	Availability on other medium
	D.A. Skoog, D.M. West, F.J. Holler, Osnove analitičke kemije, Školska knjiga Zagreb, 1999.					
Supplementary literature						
Quality assurance	Quality of the teaching and learning, monitored at the level of the (1) teachers, accepting suggestions of students and colleagues, and (2) faculty, conducting surveys of students on teaching quality.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">Instrumental Methods of Chemical Analysis</td></tr>
<tr><td>ID</td><td>PMB731</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivana Mitar</td><td>Points value (ECTS)</td><td colspan="4">3.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Adopt and understand the basics principles and application of instrumental analytical methods of physico-chemical analysis.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Knowledge of basic analytical methods of instrumental analysis.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">-explain the physico-chemical fundamentals of particular method of instrumental analysis,
-distinguish methods by types of testing
-select the appropriate test method according to the types of samples to be tested
-explane and interpret the results of analyzes</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures:
Spectroscopy
1. Introduction to spectroscopic methods, instruments in spectroscopy (2 lessons)
2. UV-Vis, Fluorescence spectroscopy (2 lessons)
3. IR and Raman spectroscopy (1,5 lessons)
4. Atomic spectroscopy (1 lesson)
5. Mass spectrometry (1,5 lessons)
6. NMR (1 lessons)
Chromatography
7. Introduction to chromatographic methods (TLC, column chromatography) (2 lessons)
8. Liquid chromatography -HPLC (size ex., ion, affinity) (1,5 lessons)
9. Gas chromatography -GC (1,5 lessons)
10. Electrophoresis, thermophoresis, isoelectric focusing (1 lesson)
Exercises:
Spectroscopy
1. UV/Vis and Fluorescence spectroscopy (3 hours)
2. IR and Raman spectroscopy (3 hours)
3. Electrophoresis (3 hours)
Chromatography
4. HPLC-chromatography (3 hours)
5. GC- chromatography (3 hours)</td></tr>
</table>

Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☑ Multimedia ☑ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	Students are required to attend classes (lectures and seminars 80%, laboratory practice and field work 100%) and actively participate in the teaching process. This will be recorded and evaluated in making a final assessment.		

Monitoring student work						
	Class attendance	0.5	Research		Practical work	1
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	1.5		
	Written exam	1	Project			

Assessment and evaluation of student work	Course content is divided into two units that students can pass through partial exams during semester or through a final exam at the end of the semester. The exam is considered passed if students achieve at least 50% of the total number of points. After passing the written part of the student acquires the right to exit the oral exam. The final grade is based on the rating of written and oral examination.The final grade is based on the evaluation of partial exams. Grades: <50% not satisfied; 50-60% successful (2) 60-70% good (3), 70-85% very good (4), 85-100% excellent (5).

Required literature	Title	Number of copies available	Availability on other medium
	1. D.A. Skoog, D.M. West, F.J. Holler, Osnove analitičke kemije, Školska knjiga Zagreb, 1999.		

Supplementary literature	
Quality assurance	Quality of the teaching and learning, monitored at the level of the (1) teachers, accepting suggestions of students and colleagues, and (2) faculty, conducting surveys of students on teaching quality.
Other (in the opinion of the proponent)	

Subject name	Research Project						
ID	PMP134	Study year	2.				
Lecturer	doc. dr. sc. Marko Kovač	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			0	30	0	0	
Subject status	Elective	Online percentage	0%				
Subject description							
Subject goals	1. Train students for independent research. 2. Learn how to interpret and present research results. 3. Encourage independent research.						
Enrolment requirements	Acquired learning outcomes of the following courses: 1. Special Theory of Relativity 2. Elementary Particle Physics I 3. Stochastic Simulations in Classical and Quantum Physics						
Learning outcomes	1. Poznavanje izrade fizikalnih modela za odabrane probleme iz astrofizike i fizike osnovnih čestica. 2. Poznavanje analize podataka u astrofizici i fizici elementarnih čestica. 3. Poznavanje planiranja istraživanja. 4. Priprema pismenog seminara. 5. Usmeno izlaganje.						
Syllabus	1. Knowledge of making a physical model for a selected problem in Astrophysics and Elementary Particle Physics. 2. Knowledge of data analysis in Astrophysics and Elementary Particle Physics. 3. Knowledge of research planning . 4. Preparing a written seminar. 5. Oral presentation.						
Teaching types	☐ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☑ Combined online	☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☑ Laboratory ☑ Mentoring	☐ ☐ ☐ ☐				
Student obligations	Regular consultations with the teacher. Regular reports by students on research progress.						
Monitoring student work	Class attendance		Research	4	Practical work		
	Experimental work		Paper				

	Essay	1	Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	Continuous monitoring of problem-solving progress. Evaluation of written summary and presentation of results.					
Required literature	Title	Number of copies available		Availability on other medium		
	–					
Supplementary literature	Depending on the research topic.					
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.					
Other (in the opinion of the proponent)						

Subject name	Research in Computational Physics I		
ID	PMP276	Study year	1.
Lecturer	doc. dr. sc. Željka Sanader Maršić	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 0, S: 20, E: 0, P: 0
Subject status	Elective	Online percentage	20%

Subject description			
Subject goals	Osposobiti studente za izradu fizikalnih modela, programiranja i simulacija te drugih programskih aktivnosti, s ciljem rješavanja složenih problema u fizici i interdisciplinarno.		
Enrolment requirements	Ishodi učenja preddiplomskog studija Fizike.		
Learning outcomes	– istražiti, izraditi i prezentirati fizikalni model za odabrani problem u fizici ili interdisciplinarno – izraditi program ili prilagoditi postojeće složene programske pakete za odabrani problem – izvršiti simulaciju fizikalnog modela ili drugi oblik pokretanja odabranog programa – pripremiti seminar i prezentirati rad		
Syllabus	1. Principi izrade fizikalnih modela 2. Izrada programskog paketa i prilagodba odabranih postojećih složenih programa u fizici 3. Simulacija odabranih programa 4. Vizualizacija procesa i rezultata 5. Povezivanje s mjerenjima i njihova provedba uz pomoć računala		
Teaching types	☐ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring	☐ ☐ ☐ ☐
Student obligations	Pripremiti fizikalni model za odabrani problem. Pripremiti program ili prilagoditi odabrane programske pakete Izvršiti simulacije ili druge oblike provođenja programa. Pripremiti i prezentirati seminarski rad.		

Monitoring student work						
	Class attendance		Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	1		
	Colloquiums		Oral exam			
	Written exam		Project	4		

Assessment and evaluation of student work	Priprema i prezentacija rada programa (100 %)		
Required literature	Title	Number of copies available	Availability on other medium
	Različiti programski paketi i upute		
Supplementary literature			
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Research in Biophysics</td></tr>
<tr><td>ID</td><td>PMP407</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Lucija Krce</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>10</td><td>20</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">To train students towards independent research, with the participating in development, measurement, analysis and presentation of scientific projects in biophysics and bio-science.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">The learning outcomes of Bachelor programmes in physics, basic knowledge in molecular biology and biochemistry.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">On completion of this course a student should be able to:
1. Explore, develop and present a physical model for the selected problem in biophysics or interdisciplinary.
2. Depending on the research subject, get familiar with the techniques and methods applied in the biophysical or interdisciplinary research.
3. Prepare and present a seminar work.
4. Develop a critical understanding of scientific investigation in biophysics and interdisciplinary and ability to describe and present such research.</td></tr>
<tr><td>Syllabus</td><td colspan="6">The course depends on the research subject, with the general content:
1. Definition of a research problem
2. Literature search
3. Definition of a physical model
3. Measurements, simulations, bioinformatical analysis, programming ...
4. Analysis and calculation
5. Writing seminar
6. Presentation</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☑ Mentoring</td><td colspan="4">☑ Aktivni rad studenata, uz stručno vođenje.
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Independently, with the professional guidance, to complete and present small scientific project.</td></tr>
</table>

Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper		Samostalna mjerenja, analiza i prezentiranje rada	4
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	Preparation and presentation of the research (100%).					
Required literature	Title				Number of copies available	Availability on other medium
	Depending on the choice of the research subject					
Supplementary literature						
Quality assurance	1. Analysis of the acquired learning outcomes at the end of the class, compared with the introductory work of students. 2. Monitoring the development of students in the subjects who followed the links with the success of the case. 3. Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">Research in Environmental Physics</td></tr>
<tr><td>ID</td><td>PMP26C</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Žarko Kovač
izv. prof. dr. sc. Jadranka Šepić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>10</td><td>20</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">– train students for independent research
– acquire skills of presentation of scientific results according to the standards of the profession
– encouraging independent research</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">– Introduction to Fluid Mechanics
– Meteorology I
– Ocean Physics I
– Introduction to Data Analysis
– Meteorology II
– Ocean Physics II</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">– knowledge of making a physical model for a selected problem in environmental physics
– knowledge of research planning
– depending on the choice of research topic, knowing specific techniques and Methods of measurement and data processing
– depending on the choice of research topic, knowing specific techniques and modelling methods
– preparing a written seminar
– oral presentation</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Review of current research in environmental physics (10 hours of lectures)
2. Definition of the research problem (*)
3. Literature search (*)
4. Analysis of the theoretical model (*)
5. Presentation of the theoretical foundations of the research topic (10 hours of seminars)
6. Measurements, simulations, development of computer programs (*)
7. Analysis and data processing (*)</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">8. Presentation of quantitative research results (10 hours of seminars)
9. Writing a seminar (*)
* The exact number of hours of practice of each teaching unit depends on the research topic.</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☑ Seminars
☑ Exercises
☐ Fully online
☑ Combined online</td><td colspan="3">☑ Fieldwork
☑ Individual assignments
☑ Multimedia
☑ Laboratory
☑ Mentoring</td><td>☑ Homework
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Attend at least 70% of lectures and 70% of exercises.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td>0.5</td></tr>
<tr><td>Experimental work</td><td>0.5</td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>1</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td>2</td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">For the first 5 weeks, the teacher gives lectures on current research topics in environmental physics (models, measurements, instrumentation). By the end of the 5th week of classes, the student chooses a topic and a mentor. Depending on the topic, the student also receives a co-mentor who can be from an external institution. In weeks 6 - 15, the student conducts research by attending individualized exercises adapted to the research topic. At the end of week 10, he presents the theoretical foundations of the research topic. At the end of week 15, the student presents the quantitative results of the research. He then submits a written seminar containing theory and results. Students who do not present theoretical or quantitative results, or do not submit a seminar, lose the right to take the exam.</td></tr>
<tr><td rowspan="2">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">- books depending on the research topic</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">- papers depending on the research topic</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

Subject name	Research in Computational Physics II						
ID	PMP277	Study year	2.				
Lecturer	doc. dr. sc. Ivana Weber	Points value (ECTS)	5.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			5	15	0	0	
Subject status	Elective	Online percentage	50%				

Subject description

Subject goals	Samostalno provedeno istraživanje, koje uključuje primjenu neke od metoda računarske fizike. Razvoj sposobnosti vizualizacije, kritičke evaluacije i prezentacije dobivenih rezultata.
Enrolment requirements	Osnove programiranja.
Learning outcomes	Nakon položenog predmeta student bi trebao: –Kritičko vrednovati teorije, podatke i rezultate numeričkih proračuna. – Primijeniti i prilagoditi neku od naprednih metoda računarske fizike na rješavanje novih i složenih problema – Formulirati i oblikovati rezultate istraživanja – Prezentirati rezultate svog istraživačkog rada.
Syllabus	Definiran je temom istraživačkog projekta. Studentima će se prezentirati odabrane napredne metode računalne fizike te prezentirati ponuđene teme istraživanja. Nakon samostalnog rada i konzultacija s nastavnikom studenti će prezentirati rezultate svojih istraživanja.
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☑ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring ☐ ☐ ☐ ☐
Student obligations	Pohađanje nastave. Samostalno provođenje istraživanja uz konzultacije s nastavnikom i priprema seminarskog rada. Prezentacija rezultata rada.

Monitoring student work						
	Class attendance	0.2	Research	4.3	Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation	

of student work	Ocjena će biti određena na temelju vrednovanja rezultata dosegnutih u istraživačkom radu		
Required literature	Title	Number of copies available	Availability on other medium
	Znanstveni članci (ovisno o tematici projekta)		Online baze podataka
Supplementary literature	Redovito praćenje napretka studenta u projektu. Ankete.		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="5">Extracurricular Activities</td></tr>
<tr><td>ID</td><td>PMS173</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>Antonija Bašić, pred.</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">To become aware of the importance of extracurricular activities to develop children's interests, the satisfaction of their personal needs and motivations, and the possibilities of professional guidance.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Pedagogy (79121) and Didactics (79107) passed</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Qualification for planning, programming and implementation of extracurricural activities
2. Perceiving dispositions potential and possible talents
3. To qualify for monitoring and evaluation of students' achievements and inclination
4. The understanding of the essence of free creative work and the characteristics of gifted pupils</td></tr>
<tr><td>Syllabus</td><td colspan="6">1.Etymologically and contents related concepts 2. Causes, reasons and conditions of introducing extracurricular activities 3. Functions of extracurricular activities 4. Tasks of extracurricular activities 5. The principles of the organization of extracurricular activities 6. Types of extracurricular activities regarding the content 7. Organizing embodiments of extracurricular activities 8-9. Creativity 10/11. Creativity and thinking 12-13. The creative act - the processes and dimensions 14./15.Creativity and education</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="2">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td colspan="3">☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Class attendance, preparation and presentation of the seminar paper, preliminary exams or an exam.</td></tr>
</table>

Monitoring student work	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam	1		
	Written exam		Project			

Assessment and evaluation of student work	Class attendance, activity, the quality of seminar paper presentation, the results of preliminary exams, exam results.		
Required literature	Title	Number of copies available	Availability on other medium
	Previšić, V. (1987.): Izvannastavne i izvanškolske aktivnosti. Školske novine, Zagreb.		
	Suhodolski, B. (1989.): Permanentno obrazovanje i stvaralaštvo. Školske novine, Zagreb.		dostupno
Supplementary literature	Težak, S. (1979.): Ciljevi, načela, sadržaji, oblici i metode rada u slobodnim aktivnostima jezično-izražajne umjetnosti. Suvremena metodika nastave hrvatskog ili srpskog jezika, Zagreb. Težak, S. (1979.): Literarne, novinarske, recitatorske i srodne družine. Školske novine, Zagreb		
Quality assurance	Consultations, discussion, active participation, evaluation.		
Other (in the opinion of the proponent)	* Seminar papers are presented in seminar groups (15x1 per group) and they represent the production of an extracurricular activity programm from the major field of study.		

Subject name	Food Carbohydrate Chemistry					
ID	PPC311	Study year	3.			
Lecturer	izv. prof. dr. sc. Renata Odžak	Points value (ECTS)	2.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			30	0	0	0
Subject status	Elective	Online percentage	10%			
Subject description						
Subject goals	Students will take the knowledge of the structure, synthesis and functions of different types carbohydrates present in the food.					
Enrolment requirements	Passed General Chemistry 1 and 2 and the attended Organic Chemistry 1 and 2					
Learning outcomes	After completing this course students will: – to distinguish between simple and complex carbohydrates in its structure – learn running carbohydrates (stereo) in several ways – learn to divide carbohydrates to D-and L-series – be able to indicate different types of connections in glycosides – know write reaction formation glycoside					
Syllabus	Lecturers: 1.Introduction to the chemistry of carbohydrates – definition, importance and classification, Monosaccharides (structure, nomenclature, stereochemistry, anomeric C atom) 2. Fischer projection formula, the D- and L-sugars, hemiacetal and hemiketal, epimers 3. Cyclic forms of carbohydrates (the ratio Haworth formulas and conformational structures), the cyclic display of glucose, fructose, galactose 4. Conformation of monosaccharides (anomeric effect), Mutorotation 5. i 6. The reactions of monosaccharides (reducing the alditols, by oxidation to aldonic acid oxidation of the monosaccharide to a weak oxidants) 7. and 8. Glycosides (structure, O-, S- N-glycosides, natural glycosides, formation and hydrolysis of the glycoside) 9. and 10. Disaccharides (reducing and non-reducing sugars, sucrose, lactose, maltose), polysaccharides (cellulose, starch, glycogen, amylose, kitin- structural features and biological properties) 11. and 12. Amino sugars, (synthesis and properties) Deoxy sugars (synthesis and properties), Analysis of carbohydrates 13. and 14. Protecting groups in carbohydrates					
Teaching types	☑ Lectures ☐ Seminars ☐ Exercises	☐ Fieldwork ☐ Individual assignments ☐ Multimedia	☐ ☐			

	☐ Fully online ☐ Combined online		☐ Laboratory ☐ Mentoring		☐ ☐	
Student obligations	Active participation in lectures.					
Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	1		
	Written exam		Project			
Assessment and evaluation of student work	Oral examination.					

Required literature	Title	Number of copies available	Availability on other medium
	Food carbohydrate Chemistry, R. E. Wrolstad, WileyBlackwell, 2012. 2)		
	Monosacharide chemistry, R. J. Ferrier and P. M. Collins, Penguin Books, Harmondsworth, 1972.		
Supplementary literature	Essenrials of carbohydrate Chemistry and biochemistry, T. K. Lindhosrst, Wiley-VCH, 2003. Organic chemistry, P.Y. Bruice, Pearson Prentice Hall, 2006.		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Kinesiological activity, fitness and health</td></tr>
<tr><td>ID</td><td>PMS135</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Mladen Hraste</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The first objective of the course is to help students in understanding and implementation of a healthy way of life. Another goal of the course to over kinesiology operators maintain and improve their health and raise their quality of life and study</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">There are no requirements for subject enrolling.
There are no entry competences required.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After completing the course students will be capable:
o to implement independent participation in fitness programs
o to implement physically active lifestyle
o to apply learned knowledge and skills needed for further independent learning and the acquisition of new motor competence
o to promote the value of an active and healthy lifestyle
o better mental and physical health</td></tr>
<tr><td>Syllabus</td><td colspan="6">1st teaching topic (2 hours of lectures): concept and definition of kinesiology; development and structure of kinesiology
2ndt teaching topic (2 hours of lectures): equation specifications in sports
3rd teaching topic (2 hours of lectures): kinesiological activity and health
4th teaching topic (2 hours of lectures): review of scientific research on the effects of kinesiology to human health
5th teaching topic (2 hours of lectures): program of contemporary aerobics
6th teaching topic (2 hours of lectures): cardio fitness program
7th teaching topic (3 hours of lectures: weight fitness program
8th teaching topic (2 hours of exercises): program of contemporary aerobics (pilates)
9th teaching topic (2 hours of exercises): program of contemporary aerobics (aerobic)
10th teaching topic (2 hours of exercises): cardio fitness program (manual i fat burn program)</td></tr>
</table>

	11th teaching topic (2 hours of exercises): cardio fitness program (high intensity interval training) 12th teaching topic (2 hours of exercises): weight fitness program for low extremities 13th teaching topic (2 hours of exercises): weight fitness program for hands and shoulders 14th teaching topic (3 hours of exercises): weight fitness program for trunk

Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐

Student obligations	Students are required to attend a minimum of 24 out of 30 planned hours (80%).

Monitoring student work	Class attendance	0.75	Research		Practical work	0.75
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam	0.5	Project			

Assessment and evaluation of student work	The course is rated as the arithmetic mean score of the practical exam and the theoretical exam. The student will get a grade excellent (5) of the practical part of the exam if motor movement performed flawlessly, easily and harmoniously. The student will get a grade very good (4) of the practical part of the exam if motor movement performed flawlessly, easily and harmoniously, but a little "harder". Students will get a good grade (3) of the practical part of the exam if motor movement performed with minor errors and with less difficulty. The student will get a grade sufficient (2) of the practical part of the exam if motor movement performed with major mistakes and with great difficulty. Students will receive an unsatisfactory grade (1) of the practical part of the exam if you can not perform a motor task is not in the elemental form. The theoretical part is taken by written test

Required literature	Title	Number of	Availability on

		copies available	other medium
	http://www.pmfst.hr/~mhraste/ Priručnik iz kolegija Kineziološka aktivnost, fitness i zdravlje		dostupno
Supplementary literature	Delavier F. (2009). Anatomski vodič za vježbe snage. Medicinska naklada, Zagreb. Milanović i sur. (1996). Fitness. Fakultet za fizičku kulturu Sveučilišta u Zagrebu, Zagrebački velesajam, Zagrebački športski savez, Fakultet za fizičku kulturu. Mišigoj-Duraković M. i sur. (1999). Tjelesno vježbanje i zdravlje. Fakultet za fizičku kulturu Sveučilišta u Zagrebu. Mraković M. (1993). Osnove sistematske kineziologije. Priručnik za sportske trenere (ur. Milanović D., Kolman M.). Fakultet za fizičku kulturu, Hrvatski olimpijski odbor, Zagrebački sportski savez. Sharkey, B. J. ; Gaskill, S. E. (2008). Fitness and health. Vežbanje i zdravlje. Beograd: Subcom.		
Quality assurance	Internal and external expert evaluation. Student evaluation.		
Other (in the opinion of the proponent)			

Subject name	Clasical Mechanics		
ID	PMP116	Study year	2.
Lecturer	izv. prof. dr. sc. Željana Bonačić Lošić	Points value (ECTS)	8.0
Associates		Class execution (number of hours in semester)	L: 45, S: 0, E: 45, P: 0
Subject status	Compulsory	Online percentage	0%

Subject description

Subject goals	Develop the student commpentences in theoretical mechanics that are useful for further studies and application in their area of expertise.
Enrolment requirements	
Learning outcomes	Student should be able to correctly state and apply the basic concepts and laws of theoretical mechanics. Construction of Lagrange function. Derivation and solving Lagrange equations. Transition from Lagrange's formalism to Hamilton's formalism. Explanation of the incompressibility of the phase space. Apply mathematical knowledge in physics.
Syllabus	Newton's laws 12. Lagrange's formalism 30. Homogeneity and isotropy of the space, homogeneity of time and conservation laws 10. Small vibrations 12. Normal coordinates 4. Dynamic of the rigid body 10. Hamilton's formalism 10. Phase space 1. Liuoville's theorem 1.

Teaching types		
☑ Lectures	☐ Fieldwork	☐
☐ Seminars	☑ Individual assignments	☐
☑ Exercises	☐ Multimedia	☐
☐ Fully online	☐ Laboratory	☐
☐ Combined online	☐ Mentoring	

Student obligations	

Monitoring student work					
Class attendance	3	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam	3		
Written exam	2	Project			

Assessment and evaluation	Preliminary exams. Written exam. Oral exams.

of student work			
Required literature	Title	Number of copies available	Availability on other medium
	H. Goldstein, Classical Mechanics, Wiley, New York, 1950	4	
Supplementary literature	L. D. Landau i E. M. Lifsic, Mehanika, Nauka, Moskva, 1979.		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Classical Mechanics I</td></tr>
<tr><td>ID</td><td>PMP110</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Željka Sanader Maršić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Formulation of the laws of classical mechanics with the development of mathematical methods for solving problems and critical assessment of their applicability to classical systems.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Mechanics (passed)
Mathematics I (passed)
Mathematics II (attended)</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Interpret and apply the fundamental principles of classical mechanics, which includes Newton's determinism, Galilean invariance, and laws of conservation of momentum, angular momentum, and energy. Use vector calculus to solve basic problems in classical mechanics.

2. Apply Newton's postulates by solving differential equations. Explain what are inertial and non-inertial reference frames.

3. Derive the equation of motion of a particle in a non-inertial frame, describe the influence of each term on the particle's motion, and analyze the impact of Coriolis force on the motion of objects close to the Earth's surface.

4. Sketch possible trajectories of a particle in the field of any central force and derive the analytical expression for the particle's trajectory in the field of several well-known central forces, including Kepler's problem. Describe the scattering experiment on a fixed target with emphasis on Rutherford's experiment.

5. Qualitatively and quantitatively analyze the motion of particle systems, different types of harmonic oscillators (explain the phenomenon of resonance), and rigid bodies (derive Euler's equations, define Euler angles, solve the problem of symmetric and asymmetric oscillations, derive the expression for the inertia tensor, and calculate it for several regular geometric bodies).</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. (3+2) Scalars, Vectors, and Tensors
2. (3+2) Kinematics
3. (3+2) Newtonian Mechanics
4. (3+2) Mechanics of Particle Systems
5. (3+2) Motion in One Dimension</td></tr>
</table>

	6. (3+2) Non-inertial Frames 7. (3+2) Central Forces 8. (3+2) Particle Scattering in a Central Force Field, 1/2 9. (3+2) Particle Scattering in a Central Force Field, 2/2 10. (3+2) Multipole Expansion of the Gravitational Potential 11. (3+2) Two-Body Problem 12. (3+2) Three-Body Problem and Lagrange Points 13. (3+2) Orthogonal Transformations 14. (3+2) Kinematics of Rigid Bodies 15. (3+2) Euler's Equations and Angles
Teaching types	[x] Lectures [ ] Seminars [x] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [x] Individual assignments [x] Multimedia [ ] Laboratory [ ] Mentoring
Student obligations	

Monitoring student work

Class attendance	2.5	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam	1.75		
Written exam	1.75	Project			

Assessment and evaluation of student work	Twice during the semester, students take a written exam covering two halves of the material. Students who score more than 50% on each exam are exempt from taking the written exam and can proceed to the oral exam. Students who score 50% or more on the first written quiz can take the oral exam in two parts, immediately after the written exam is graded. The final grade is based on the written exam (worth 1/2 of the grade) and the performance on the oral exam (worth 1/2 of the grade).

Required literature

Title	Number of copies available	Availability on other medium
Herbert Goldstein, John Safko, Charles Poole: Classical Mechanics, Pearson New International Edition, Pearson; 3rd edition (July 25, 2013)	3	no
David Morin: Introduction to Classical Mechanics: With Problems and Solutions, Cambridge University Press; 1st edition (February 4, 2008)	4	no

Supplementary literature	Slides and lecture notes.
Quality assurance	1. Teachers who have correlated learning outcomes collaborate and jointly ensure the quality of teaching. 2. Statistical analysis of exam results and evaluation of success in accordance with the stated learning outcomes. 3. Student evaluation through an anonymous survey conducted in accordance with the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="7">Classical Mechanics II</td></tr>
<tr><td>ID</td><td>PMP111</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Marko Kovač</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Formulation of the laws of classical mechanics with the development of mathematical methods for solving problems and critical assessment of their applicability to classical systems.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Mechanics (passed)
Mathematics I (passed)
Mathematics II (attended)
Classical Mechanics I (attended)</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Formulate D'Alambert's principle and apply it to several known examples of physical systems, especially the problem of static equilibrium. Derive the Euler-Lagrange equations from D'Alambert's principle.

2. Formulate the variational principle and apply it to the example of the brachistochrone, derive the Euler-Lagrange equations and apply them in describing physical systems with or without constraints.

3. Explain Hamilton's formulation of classical mechanics and the concept of phase space. Describe Legendre transformations in the context of mechanics. State and prove Liouville's theorem. Separate the Hamilton-Jacobi equation in Cartesian, cylindrical, and spherical coordinate systems.

4. Define Poisson brackets and prove their properties, define and apply canonical transformations, and explain the connection between the formalism of Poisson brackets and quantum mechanics.

5. Derive and solve the equations of motion for small oscillations. Find frequencies and normal coordinates theoretically and through examples.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. (3+2) Degrees of freedom, constraints on motion, and generalized coordinates.
2. (3+2) D'Alembert's principle and static equilibrium.
3. (3+2) Lagrangian formulation of classical mechanics, equivalence of Lagrangian and Newtonian mechanics.
4. (3+2) Hamiltonian formulation of classical mechanics.
5. (3+2) Phase space and canonical transformations.
6. (3+2) Hamilton-Jacobi formulation of classical mechanics, separation of variables in Hamilton-Jacobi equation.
7. (3+2) Liouville's theorem.</td></tr>
</table>

	8. (3+2) Poisson brackets, invariance of Poisson brackets under canonical transformations. 9. (3+2) Infinitesimal canonical transformations, Noether's theorem. 10. (3+2) Connection between Poisson brackets and quantum mechanics. 11. (3+2) Canonical perturbation theory and its application to systems with one or more degrees of freedom. 12. (3+2) Small oscillations 1/2 13. (3+2) Small oscillations 2/2 14. (3+2) Introduction to classical field theory 1/2 15. (3+2) Introduction to classical field theory 2/2

Teaching types			
	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐

Student obligations	

Monitoring student work						
	Class attendance	2.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	1.75		
	Written exam	1.75	Project			

Assessment and evaluation of student work	Twice during the semester, students take a written exam covering two halves of the material. Students who score more than 50% on each exam are exempt from taking the written exam and can proceed to the oral exam. Students who score 50% or more on the first written quiz can take the oral exam in two parts, immediately after the written exam is graded. The final grade is based on the written exam (worth 1/2 of the grade) and the performance on the oral exam (worth 1/2 of the grade).

Required literature	Title	Number of copies available	Availability on other medium
	Herbert Goldstein, John Safko, Charles Poole: Classical Mechanics, Pearson New International Edition, Pearson; 3rd edition (July 25, 2013)	3	no
	David Morin: Introduction to Classical Mechanics: With Problems and Solutions, Cambridge University Press; 1st edition (February 4, 2008)	4	no

Supplementary literature	Slides and lecture notes.
Quality assurance	1. Teachers who have correlated learning outcomes collaborate and jointly ensure the quality of teaching.

	2. Statistical analysis of exam results and evaluation of success in accordance with the stated learning outcomes. 3. Student evaluation through an anonymous survey conducted in accordance with the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Classical Electromagnetism</td></tr>
<tr><td>ID</td><td>PMP112</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Petar Stipanović</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>15</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Formulation of basic laws of classical electromagnetic theory with the development of mathematical methods for solving static problems and critical judgments of their applicability to classical physical problems.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Prior knowledge of mathematical analysis (differential and integral calculus with functions of several variables) and differential equations is required.
- Mathematical Methods of Physics I (passed)
- Differential Equations (attended)
- Electricity and Magnetism (passed)
- Waves and Optics (attended)</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Define the basic quantities and concepts of electromagnetism (electric/magnetic field, electric/magnetic potential, electric displacement, magnetic induction, field flux, polarization, susceptibility, dielectric, ferroelectric, paramagnet, diamagnet, ferromagnet) and discuss their meaning and characteristics.
2. Formulate the basic laws of electrostatics and magnetostatics in vacuum and matter (Gauss's law, Biot-Savart's law, Lorentz force, Maxwell's equations, continuity equation...) using vector analysis (vector differential operators, Gauss's and Stokes' theorem, ...) and evaluate their relevance.
3. Formulate basic quantities and laws of classical electrodynamics in vacuum and matter (Maxwell's equations in differential and integral form, mutual inductance, law of conservation of charge and energy, ...) using vector analysis and evaluate which are relevant to the given problem and describe the problem with differential/integral equations.
4. Analyze the contributions of free and bound sources of electromagnetic fields in electrically/magnetically polarized substances and determine the macroscopic effects of electrical/magnetic polarization.
5. For given constant charge/current distributions, estimate electromagnetic potentials and fields, argue their dis-/continuity at the edge and sketch the dependence of the observed quantities.
6. Expand the electric/magnetic potential in a multipole series and analyze and evaluate the contributions of the terms.
7. By superimposing known or easily determinable electromagnetic quantities, evaluate the electromagnetic interaction of distant complex systems.
8. Choose a suitable method (separation of variables in a Cartesian, spherical or cylindrical coordinate system, method of images, multipole development,...) to solve Poisson's or Laplace's equation for given or estimated boundary conditions (Dirichlet's, Neuman's or Robin's), i.e. predict electric/magnetic potential/field in a given system (e.g.</td></tr>
</table>

	charge above the ground plane, sphere of linear dielectric in a homogeneous field...). 9. Qualitatively and quantitatively compare the potentials, fields and energies for similar distributions of the corresponding sources, and based on analogies, predict the characteristics of other systems.
Syllabus	Seminars and exercises following the lectures in units: **I. ELECTROSTATICS:** **(6h) Electrostatics of various charge distributions** (vector analysis, electric force, electric field, Maxwell 's equations for electrostatics, electrical potential, energy, conductors); **(9h) Special Techniques** (Poisson and Laplace equation and boundary conditions, methods of separating variables, method of images, multipole expansion, Green's functions); **(6h) Electrostatics in matter** (polarization, volume and surface bound charges, electrical displacement, energy, linear and nonlinear matter); **II. MAGNETOSTATICS:** **(9h) Magnetostatics of various current distributions** (magnetic force, magnetic field, Biot-Savart law, Maxwell 's equations for magnetostatics, magnetic vector potential, boundary conditions, multipole expansion); **(6h) Magnetostatics in matter** (magnetization, volume and surface bound currents, magnetic field in matter, linear and nonlinear matter). **III. ELECTRODYNAMICS** **(9h) Maxwell's formulation of classical electrodynamics** (electromotive force, Faraday's law, electromagnetic induction, energy of the electromagnetic fields, Maxwell's equations and boundary conditions, conservation laws)
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	1. Active participation on lectures by giving critical judgment and argumentation of opinions, asking and answering questions. 2. Solve given problems from electromagnetism. 3. Discuss given concepts and laws and their applicability.

Monitoring student work

Class attendance	3	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper	0.5		
Colloquiums		Oral exam	1.5		
Written exam	1	Project			

Assessment and evaluation of student work	The final grade is formed after the student passes both test parts: written exam (problem solving, 50% rating) and oral exam (theory, 50% rating). During classes, short tests of learning outcomes are carried out, through which it is possible to be exempted from part of the exam, and colloquia (problems tasks) which are equivalent to the written exams.		
Required literature	Title	Number of copies available	Availability on other medium
	David J. Griffiths: Introduction to Electrodynamics, Cambridge University Press, 2017.	13	yes
	I. Supek: Teorijska fizika i struktura materije, Školska knjiga.	11	no
	Lecture notes		yes
Supplementary literature	[1] John David Jackson: Classical electrodynamics, Wiley, New York. [2] Different www-materials from electromagnetism		
Quality assurance	1. Lecturers who teach subjects, which have correlated learning outcomes, collaborate and take care of teaching quality. 2. Statistics of exam results and evaluation of efficacy in accordance with the learning outcomes. 3. Student evaluation by anonymous survey conducted according to the rules of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Climate System</td></tr>
<tr><td>ID</td><td>PMP169</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Jadranka Šepić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>35</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Provide knowledge on:
- components of natural and anthropogenic causes of climate change,
- greenhouse gases and radiation processes,
- observations of climate change parameters,
- evaluation of climate models in historical periods,
- modeling of climate parameters in future periods.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">- Meteorology I
- Ocean Physics I
- Introduction to Data Analysis
- Meteorology II
- Ocean Physics II</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Understanding of climate and paleoclimatic dynamics.
2. Understanding the causes of climate change.
3. Understanding short-term and long-term climate fluctuations by weather and climate characteristics.
4. Knowledge of theoretical and practical applications of climate models.
5. Expertise in methods of mitigating the effects of climate change on human beings activities and environment.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Natural and anthropogenic causes of climate change (2h)
2. Basic concepts of paleoclimatology (2h)
3. Observations of climate change (2h)
4. Energy balance at the earth surface and atmosphere (3h)
5. Ocean influence on climate (2h)
6. Hydrological cycle (2h)
7. Greenhouse gases (2h)
8. Aerosols and radiation processes (2h)
9. Short-term climate variabilities (El Nino, La Nina, Pacific decadal oscillation, North Atlantic oscillation, Madden-Julian oscillation) (4h)
10. Basic structure of climate models (3 hours of lectures)
11. Applications of global and regional climate models (3h)</td></tr>
</table>

	12. Uncertanties and errors of climate models (2h) 13. Projections of future climate by climate models (3h) 14. Application of climate models to the local region (1h) 14. Mitigation of climate change effects (2h)
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☑ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring ☐ ☐ ☐ ☐
Student obligations	Attend at least 70% of lectures and 70% of exercises.

Monitoring student work

Class attendance	2	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper	1		
Colloquiums		Oral exam	2		
Written exam		Project	1		

Assessment and evaluation of student work	The grade is determined on the basis of: – oral presentations, – domestic works.

Required literature

Title	Number of copies available	Availability on other medium
J. David Neelin, Climate Change and Climate Modelling, Cambridge University Press, 2011		yes
Egbert Boeker & Rienk van Grondalle, Environmental Physics: Sustainable energy and climate change, Wiley, 201		yes

Supplementary literature	[1] Intergovernmental Panel on Climate Change, Third Assessment Report of the International Panel on Climate Change. Volumes, Cambridge University Press, 2001.
Quality assurance	Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="7">Cognitive psychology</td></tr>
<tr><td>ID</td><td>PMS174</td><td>Study year</td><td colspan="5">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Nikola Marangunić</td><td>Points value (ECTS)</td><td colspan="5">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td colspan="2">P</td></tr>
<tr><td>15</td><td>15</td><td>15</td><td colspan="2">0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="5">0%</td></tr>
<tr><td colspan="8">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="7">Understanding basic psychology concepts of learning, memory, perception and intelligence. Introducing theoretical and practical fundament of acquiring knowledge and problem solving.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="7">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="7">Upon completion of the course students will be able to:
1. Describe basic concept of cognitive psychology.
2. Define cognitive neuroscience as a basis of scientific research of human cognition.
3. Describe basic cognitive processes such as attention, perception, memory and learning.
4. Name different representations of knowledge.
5. Interpret ways of problem solving for creative and gifted students.
6. Describe phases of cognitive development.
7. Interpret differences between human and artificial intelligence.</td></tr>
<tr><td>Syllabus</td><td colspan="7">1. Course introduction; 2. Introduction to the field of cognitive psychology; 3. Cognitive neuroscience; 4. Attention and awareness; 5. Perception; 6. Memory processes; 7. Knowledge representation: conceptions and propositions; 8. Representation and organization of knowledge; 9. Language: nature and acquisition; 10. Problem solving; 11. Creativity; 12. Gift/Talent; 13. Decision making and reasoning; 14. Cognitive development; 15. Human and artificial intelligence.</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☑ Exercises
☐ Fully online
☑ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td colspan="5">☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="7">Attending and activity in classes, individual tasks, work on the project, project presentation.</td></tr>
<tr><td rowspan="4">Monitoring student work</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td colspan="2"></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr>
</table>

	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	Nazočnost na nastavi, aktivnost na nastavi, izrada samostalnih zadataka, rad na projektu, završni projekt.					
Required literature	Title	Number of copies available		Availability on other medium		
	–					
Supplementary literature	1. Zarevski, P. (2007). Psihologija pamćenja i učenja. Naklada Slap, Jastrebarsko. 2. Howe, M. J. A. (2002). Psihologija učenja. Naklada Slap, Jastrebarsko. 3. Rathus, S. A. (2001). Temelji psihologije. Naklada Slap, Jastrebarsko					
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split					
Other (in the opinion of the proponent)						

Subject name	Combinatorics		
ID	PMM804	Study year	2.
Lecturer	doc. dr. sc. Aljoša Šubašić	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 30, P: 0
Subject status	Compulsory	Online percentage	30%

Subject description	
Subject goals	The aim of the course is to introduce students to the basic topics of combinatorics and discrete mathematics. Students will: learn how to count some different types of discrete structures using counting techniques; adopt basic properties of some discrete structures, and learn how to relate these to practical examples.
Enrolment requirements	Prerequisites: Taken courses Differential and integral calculus I and Linear algebra Entry competences: Students should be familiar with using the concepts of elementary mathematics, differential and integral calculus and vector spaces.
Learning outcomes	Students will be able to : • formulate theorems and definitions of important concepts in discrete mathematics, and illustrate them with discrete mathematics examples. • construct mathematical proofs, • solve problems using counting techniques, recurrence relations and generating functions, • apply the obtained knowledge and skills to investigate and solve a variety of discrete problems.
Syllabus	Introduction to combinatorics. Counting techniques, Dirichlet's principle, Ramsey numbers. (5) Permutations and combinations of sets and multisets. Binomial and multinomial coefficients. Inclusion-exclusion. (11) Recurrence relations, generating functions. Solving recurrences using generating functions. (10) Some highlighted topics in discrete mathematics. (4)

Teaching types			
	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐

Student obligations	Class attendance. Students are expected to be present at least 70% of classes.

Monitoring student work						
	Class attendance	2	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			

	Colloquiums		Oral exam	1.5		
	Written exam	1.5	Project			
Assessment and evaluation of student work	Two partial written exams / one final written exam and final oral exam. There are 2 partial written exams during the semester. Passing the both partial exams or the final written exam allows students to take the oral exam. Successfully passing the oral exam leads to a successful completion of the course.					

Required literature	Title	Number of copies available	Availability on other medium
	D. Veljan, Kombinatorna i diskretna matematika, Algoritam, Zagreb, 2001		
	D. Veljan, Kombinatorika s teorijom grafova, Školska knjiga, Zagreb, 1989.		
	M. Cvitković, Kombinatorika, zbirka zadataka, Element, Zagreb, 1994		

Supplementary literature	J. Matoušek, J. Nešetril, Invitation to Discrete Mathematics, Oxford University Press, Oxford, 1998. Peter J. Cameron, Combinatorics: Topics, Techniques, Algorithms. Cambridge University Press, Cambridge. 1994. (2nd edition) 1996. Peter J. Cameron, Notes on Combinatorics, http://www.maths.qmul.ac.uk/~pjc/notes/comb.pdf
Quality assurance	Anonymous student evaluations according to the regulations of the University of Split and summarizing test results.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Complex analysis</td></tr>
<tr><td>ID</td><td>PMM116</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Jurica Perić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Aim of the course aims is to introduce basic concepts and results from the theory of complex functions of a complex variable, with an emphasis on the theory of analytical functions. Students must develop the ability of understanding the results presented in the lectures as well as setting up and solving tasks and problems that may be found in connection with these results. Techniques to solve tasks students acquire on the exercises.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Taken course „Foundation of mathematical analysis“.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">The student is able to:
– analyze the topological properties of a set of complex numbers
– analyze the importance of the Cauchy–Riemann conditions
– distinguish differentiable complex functions and functions of real variables
– connect differentiability with integral along closed curve (general Cauchy theorem)
– relate analyticity and development in order (Taylor and Laurent Development)
– classify singularities (pole, removable and essential singularity)
– apply the acquired knowledge on residuums in the calculation of special improper integrals</td></tr>
<tr><td>Syllabus</td><td colspan="6">Complex numbers C – 2 hours
Convergence of the series, closer of the set – 2 hours
Complex functions of complex variables, continuity, limit – 2 hours
Completeness – 2 hours
Compactness – 2 hours
Analytic functions, Cauchy–Riemann theorem – 2 hours
Integral of the complex function – 2 hours
General Cauchy theorem – 2 hours
Cauchy's integral formula – 2 hours
Series of functions – 2 hours
Uniformly convergent series of functions – 2 hours
Taylor and Laurent theorem – 2 hours
Isolated singularities – 3 hours
Residuum theorem and applications – 3 hours</td></tr>
</table>

<table>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Attendance at 70% of lectures.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td>1</td><td>Oral exam</td><td>3</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">The exam is taken in written and oral form. Written exam is preliminary part of the exam and requirement for the oral exam is to pass a written exam. The written form of the exam can be taken partially, during class, where curriculum provided. Activity in class, solving homework, colloquium, written and oral examination are the elements from which form the final grade is formed.</td></tr>
<tr><td rowspan="4">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">B. Červar, Kompleksna analiza, skripta</td><td></td><td></td></tr>
<tr><td colspan="4">Š. Ungar, Matematička analiza 4, (skripta), Zagreb, 2001.</td><td></td><td></td></tr>
<tr><td colspan="4">H. Kraljević, S. Kurepa, Matematička analiza 4/I: Funkcije kompleksne varijable, Tehnička knjiga, Zagreb, 1986.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">S. Kurepa, Matematička analiza III, Tehnička knjiga, Zagreb, 1975.

W. Rudin, Real and complex analysis, McGraw-Hill, New York, 1970.</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="7">Communication Skills</td></tr>
<tr><td>ID</td><td>PMSN09</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>Ana Mršić Zdilar, pred.</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">• to understand the basic concepts related to verbal and nonverbal communication, as well as the factors that influence these concepts;
• to develop the skills of presentation planning, presentation structure, and presentation performance in the Croatian language;
• to develop pragmatic language competence;
• to adopt the basic principles of written communication.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">tudents will be able to:
1. describe the theories and models of communication;
2. employ active listening techniques;
3. demonstrate questioning skills;
4. give a technical presentation;
5. critically evaluate their own communication skills;
6. recognize disfluent speech;
7. negotiate and demonstrate the skills of assertive communication</td></tr>
<tr><td>Syllabus</td><td colspan="6">Definitions of communication; Overview of the theory of communication;
Cross-cultural communication
Verbal and nonverbal communication
Questioning as a communication skill
Active listening and Barriers to active listening
Written communication; Project reports
Presentation skills (systematic guide)
Technical presentation
Technical presentation and peer evaluation
Assertive communication and Critical thinking
Public speaking skills
Types of speech disfluencies
Group and Team communication</td></tr>
</table>

Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Active participation in all activities: lectures, consultations, searching the literature, individual work.

Monitoring student work:

Class attendance	0.5	Research		Practical work	
Experimental work		Paper	1		
Essay		Seminar paper			
Colloquiums		Oral exam			
Written exam	0.5	Project			

Assessment and evaluation of student work	The final grade is determined as the average of: • assessment of oral presentation and peer assessment of oral presentation; • assessment of written communication skills, • written and oral assessment.

Required literature:

Title	Number of copies available	Availability on other medium
–		

Supplementary literature	1.Davies, J. W.: Communication skills: A Guide for Engineering and Applied Science Students. Pearson: Prentice Hall, 2001. 2.Harris, T. E., Sherblom, J.C.: Small Group and Team Communication. Pearson Education/Allyn & Bacon, 2010.
Quality assurance	• Vođenje evidencije o prisutnosti na nastavi • Godišnja analiza uspješnosti polaganja ispita • Studentska anketa s ciljem evaluacije nastavnika • Samoevaluacija nastavnika • Povratna informacija od strane studenata koji su već diplomirali o relevantnosti sadržaja predmeta
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Vertebrates</td></tr>
<tr><td>ID</td><td>PMB517</td><td>Study year</td><td>3.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Antonela Sovulj</td><td>Points value (ECTS)</td><td>6.5</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 30, S: 15, E: 30, P: 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>0%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3"></td></tr>
<tr><td>Enrolment requirements</td><td colspan="3"></td></tr>
<tr><td>Learning outcomes</td><td colspan="3"></td></tr>
<tr><td>Teaching types</td><td>☐ Lectures
☐ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3"></td></tr>
<tr><td>Monitoring student work</td><td colspan="3">Class attendance | Research | Practical work
Experimental work | Paper
Essay | Seminar paper
Colloquiums | Oral exam
Written exam | Project</td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="3"></td></tr>
<tr><td>Required literature</td><td colspan="3">Title | Number of copies available | Availability on other medium
–</td></tr>
<tr><td>Supplementary literature</td><td colspan="3"></td></tr>
<tr><td>Quality assurance</td><td colspan="3">Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="3">Cryptography</td></tr>
<tr><td>ID</td><td>PMM205</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Borka Jadrijević</td><td>Points value (ECTS)</td><td>5.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td><table><tr><td>L</td><td>S</td><td>E</td><td>P</td></tr><tr><td>30</td><td>15</td><td>15</td><td>0</td></tr></table></td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>40%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">The objective of this course is to introduce students to the basic ideas, techniques and algorithms used in cryptography and its applications. The course is a good background for understanding and learning more advanced courses in this area.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Completed course: Introduction to number theory</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Upon successful completion of the course, the student is able to:
-decrypt messages encrypted using the different types of substitution ciphers and columnar transposition;
-describe the basic steps in modern block cryptosystems DES and AES;
-describe ideas of public-key cryptography and digital signature;
-define RSA cryptosystem and its connection with factorization of large integers;
-encrypt messages using public-key cryptosystems (RSA, Rabin, ElGamal, Merkle-Hellman);
-cryptoanalyze RSA cryptosystem with small public or secret exponent;
-define elliptic curve and describe the use of elliptic curves in cryptography;
-define notions of (Euler, strong) pseudoprime numbers and determine whether an integer is a pseudoprime;
-describe the most famous algorithms for primality testing and integral factorization.</td></tr>
<tr><td>Syllabus</td><td colspan="3">- Traditional ciphers.Basic notions. Caesar, Vigenère, Playfair and Hill's cipher. Statistical methods for cryptanalysis. Encryption devices. (7 hours)

- Modern Block Ciphers. Data Encryption Standard (DES). Cryptanalysis of DES. Advanced Encryption Standard (AES). (6 hours)

- Public-Key Cryptography.Concept of public-keycryptography. Digital signature. RSA cryptosystem. Other public-key cryptosystems. Cryptanalysis of public-key cryptosystem. Elliptic curves in cryptography. (9 hours)

- Primality Testing and Integral factorization. Pseudoprime numbers. Soloway-Strassen and Miller-Rabin primality test. Factor base. Continued fraction factorization method. Quadratic sieve factoring algorithm. (8 hours)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars</td><td>☐ Fieldwork
☐ Individual assignments</td><td>☐</td></tr>
</table>

	☑ Exercises ☐ Fully online ☐ Combined online		☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐	
Student obligations	Attendance of lectures and tutorial sessions is obligatory. Students should present a seminar and solve the homework assignments.					
Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper		Domaće zadaće	1.5
	Essay		Seminar paper	1		
	Colloquiums		Oral exam	1.5		
	Written exam		Project			
Assessment and evaluation of student work	Successful seminar and success in solving homework assignments are prerequisites for the oral exam. All parts of the exam are equally weighted in the final grade.					

Required literature	Title	Number of copies available	Availability on other medium
	A.Dujella, M. Maretić: Kriptogrfija, Element, Zagreb, 2007.;	3	
	D. R. Stinson: Cryptography. Theory and Practice, CRC Press, Boca Raton, 2002.	1	
	N. Koblitz: A Course in Number Theory and Cryptography, Springer-Verlag, New York, 1994.	2	
Supplementary literature	N. Smart: Cryptography. An Introduction, McGraw-Hill, New York, 2002;		
Quality assurance	Statistics of test results and anonymous student evaluations at the end of the semester according to the regulations of the University of Split.		
Other (in the opinion of the proponent)			

Subject name	Quantum Physics					
ID	PMP117	Study year	3.			
Lecturer	prof. dr. sc. Leandra Vranješ Markić	Points value (ECTS)	6.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			40	15	30	0
Subject status	Compulsory	Online percentage	10%			
Subject description						
Subject goals	To teach students basic concepts in quantum mechanics and their application to simple problems and hydrogen atom.					
Enrolment requirements	Learning outcomes in general physics, classical mechanics, linear algebra and differential equations.					
Learning outcomes	1. Explain and apply concepts and principles of quantum mechanics (Schrödinger equation, wave function, probability amplitude, state space, physical observables and operators, wave equation, superposition and complementarity, time evolution, expectation values, matrix representation) and connect them to experimental realisations. 2.Discuss and apply the Heisenberg uncertainty relations, determine commutators for different pairs of operators and discuss the consequence of uncertainty relations on measurement of corresponding physical properties. 3. Discuss and solve time-independent Schrödinger equation for bound and scattering states for important one dimensional systems (e.g. square well, harmonic oscillator, potential barrier), interpret obtained wave functions and calculate the expectation values of particular quantities (position, momentum, energy), probabilities and time evolution of solutions, as well as the coefficients of reflection and transmission. 4.Discuss the concept of angular momentum in quantum mechanics, its connection with rotation operator and determine its eigenvalues and eigenfuctions. 5. Discuss and solve time-independent Schrödinger equation for bound and scattering states for important potentials (free particle, particle in a box, harmonic oscillator), interpret obtained wave functions and calculate the expectation values of particular quantities (position, momentum, energy), probabilities and time evolution of solutions 6. Discuss ad solve quantum description of hydrogen atom, determine eigenfunctions and eigenvalues and connection to experiments. 7. Discuss the concept of spin, calculate eignefunctions and eigenvalues of spin operator.					
Syllabus	1. Wave-particle duality. Stern-Gerlach experiment. Analogy with polarisation of light. (5h) 2. Mathematical tools of quantum mechanics; Hilbert spaces, wave functions and Dirac notation (5h) 3. Operators. Uncertainty relations. (5h) 4. Representation in discrete and continuous bases. (5h) 5. Postulates of quantum mechanics. (5h) 6. Measurement and observables. (5h) 7. Time evolution. Schrodinger equation. Stationary states. Time evolution of					

	expectation values. Wave packets. (8h) 8. Symmetries and conservation laws. (2h) 9. The Ehrenfest theorem. Connecting quantum to classical mechanics. (3h) 10. General properties of Schrodinger equation in 1D. The infinite square well potential. (4h) 11. One dimensional problems with potential barriers. (6h) 12. Harmonic oscillator. (6h) 13. General formalism of angular momentum and matrix representation. Eingenstates of orbital angular momentum. (8h) 14. Problems in three dimensions. Hydrogen atom. (10h) 15. Spin. Application (8h).

Teaching types	☐ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☑ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	Active participation during class attendance.		

Monitoring student work	Class attendance	3	Research		Practical work	
	Experimental work		Paper		Samostalni rad i ispit	3
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	Colloquia and final exam.

Required literature	Title	Number of copies available	Availability on other medium
	N. Zettili, „Quantum Mechanics: Concepts and applications“	4	
	Web pages with solved examples		Moodle, Web page
	Popular articles		Moodle, Web page
			Moodle, Web

	Presentations from lectures		page
Supplementary literature	1. R. Scherrer „Quantum mechanics: An Accessible Introduction“ 2. R. L. Liboff, „Introductory Quantum Mechanics“ 3. D. J. Griffits, “Introduction to QuantumMechanics” 4. Auletta, Genaro, Parisi, “QuantumMechanics”		
Quality assurance	– following the success of students in colloquia and exam – following the student success in the following exams and the connection to the success of this course – student surveys		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Quantum Computing</td></tr>
<tr><td>ID</td><td>PMP202</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Leandra Vranješ Markić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>15</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Introduce students to realisations of quantum computers, basics of quantum computing, important quantum algorithms and their application.
Develop skills of the design of quantum programs and their execution of quantum computers and simulators.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Competences from quantum physics course.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After successful completion of the course the students will be able to:
1) discuss advantages and disadvantages of quantum computing with respect to classical computing;
2) explain basics models of quantum computing and the structure of introduces quantum algorithms and protocols;
3) discuss basic hardware realisations of quantum computers;
4) solve quantum-computing reversible logic gates with single and multi qubit states;
5) program simple quantum algorithms on cloud quantum computer or simulator;
6) discuss and apply basic error correcting codes.</td></tr>
<tr><td>Syllabus</td><td colspan="6">• Qubit representation. Elementary quantum gates and basic quantum computing formalism (8 hours)
• Comparison between quantum and classical computing. Complexity classes (2 hours)
• Elements of quantum programs. Introduction to libraries for quantum computing (4 hours)
• Superdense quantum coding. Teleportation and Bells inequalities (4 hours)
• Other models of quantum computing: measurement-based quantum computing and adiabatic quantum computing (2 hours)
• Quantum algorithms. Deutsch-Jozsa's algorithm. (5 hours)
• Bernstein-Vazirani's algorithm (3 hours)
• Simon's algorithm. Grover's algorithm. (6 hours)
• Quantum Fourier transform. Shor's algorithm. (6 hours)
• Hybrid algorithms. Variational quantum eigensolver and applications. (6 hours)
• Quantum error correction. (6 hours)
• Hardware realisations of quantum computers. (4 hours)
• Modern applications of quantum computers. (4 hours)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars</td><td colspan="2">☐ Fieldwork
☑ Individual assignments</td><td colspan="3">☐</td></tr>
</table>

	☑ Exercises ☑ Fully online ☐ Combined online		☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐	
Student obligations	Active participation in lectures, seminars and exercise classes.					
Monitoring student work	Class attendance	2	Research		Practical work	4
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	Homework assignments, seminar, final exam					
Required literature	Title				Number of copies available	Availability on other medium
	M. A. Nielsen and I. L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press, Cambridge, 2010.					
	Ph. Kaye, R. Laflamme and M. Mosca, An Introduction to Quantum Computing, Oxford University Press, Oxford, 2007.					
Supplementary literature	Jack D. Hidary, Quantum Computing: An Applied Approach, Springer, 2nd edition, 2021 – uz popratne kodove na GitHub-u Original papers and preprints.					
Quality assurance	Monitoring success in exams. Discussion with students and analysing their progress in solving problem and assignments. Student evaluation by anonymous survey conducted according to the rules of the University of Split.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="3">Linear Algebra I</td></tr>
<tr><td>ID</td><td>PMM153</td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Tea Martinić Bilać</td><td>Points value (ECTS)</td><td>8.5</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td><table><tr><td>L</td><td>S</td><td>E</td><td>P</td></tr><tr><td>45</td><td>0</td><td>60</td><td>0</td></tr></table></td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>15%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">The aim of the course is to introduce students to the knowledge and skills in classical algebra of vectors and analytic geometry. Students will adopt an elementary knowledge in basic algebraic structures and vector spaces.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Prerequisites: none

Entry competences: Knowledge of secondary school mathematics</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Students will be able to:

– formulate the theorems and definitions of classic algebra of vectors, analytic geometry, and elementary algebraic structures,

– present in a clear manner correct mathematical reasoning and proofs,

– distinguish and give examples of elementary algebraic structures,

– demonstrate understanding of the concepts of vector space and subspace,

– solve problems within the course content.</td></tr>
<tr><td>Syllabus</td><td colspan="3">Introduction – coordinate systems (2)
–Cartesian coordinate systems on the line, plane and in space.

Classical vector algebra. (11)
–Oriented lines and radius vectors. Basic operations with vectors and coordinatization. (4)
–Vectors. Collinearity and coplanarity. Basis and dimension. Coordinate space. (4)
–Inner product. Orthonormal basis. Inner product in coordinates. Outer product. Mixed product. (3)

Analytical geometry in E3. (13)</td></tr>
</table>

	-Different plane equations. Point-plane distance, angle between two planes. (4) -Line equations in space. Angle between lines and planes. Point-line distance. Common normal and distance between two lines. (3) -Second order plane curves. Second order surfaces. (3) -Polar, cylindrical and spherical systems. (3) Algebraic structures. (9) -Binary operations. Groupoid, semigroup, monoid, group - definitions, examples, basit properties. (3) -Cyclic groups and permutation groups. (3) -Group homomorphism - definition and examples. (1) -Ring - definition and examples, basic properties. (1) -Division ring and field. (1) Linear spaces. (10) -Definition and examples. (2) -Linear (in)dependence. Basis and dimension. (4) -Subspaces, intersection and sum. Quotient space. (4)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Class attendance. Students are expected to be present at least 70% of classes.

Monitoring student work						
	Class attendance	3	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	3		
	Written exam	2.5	Project			

Assessment and evaluation of student work	There are 2 partial written exams during the semester and the final exam. Passing of either the partial exams or the written exam allows students to take the final (oral) exam. Successfully passing the oral exam leads to a successful completion of the course.

Required literature		Number of	Availability on

	Title	copies available	other medium
	K. Horvatić, Linearna algebra I i II, PMF - Matematički odjel, HMD, Zagreb, 1995.		
	N. Elezović, A. Aglić, Linearna algebra, Element, Zagreb, 1999.		
	N. Bakić, A. Milas, Zbirka zadataka iz linearne algebre s rješenjima, PMF-Matematički odjel, HMD, Zagreb, 1995.		
	N. Elezović, A. Aglić, Linearna algebra, Zbirka zadataka, Element, Zagreb, 1999.		
Supplementary literature	B. Pavković, D. Veljan, Elementarna matematika 2, Školska knjiga, Zagreb, 1994. S. Kurepa, Konačnodimenzionalni vektorski prostori i primjene, Liber, Zagreb 1992.		
Quality assurance	Anonymous student evaluations according to the regulations of the University of Split and summarizing test results.		
Other (in the opinion of the proponent)			

Subject name	Linear algebra II		
ID	PMM154	Study year	1.
Lecturer	prof. dr. sc. Borka Jadrijević	Points value (ECTS)	8.5
Associates		Class execution (number of hours in semester)	L: 45, S: 0, E: 60, P: 0
Subject status	Compulsory	Online percentage	10%

Subject description	
Subject goals	
Enrolment requirements	
Learning outcomes	
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	

Monitoring student work						
	Class attendance	2.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	3		
	Written exam	3	Project			

Assessment and evaluation of student work			
Required literature	Title	Number of copies available	Availability on other medium
	K. Horvatić, Linearna algebra, Golden marketing, Tehnička knjiga, Zagreb, 2004. dovoljan da		DA
Supplementary literature	1. Damir Bakić, Linearna algebra, Školska knjiga, Zagreb, 2008.		

	2. S.H. Friedberg, A.J. Insel and L.E. Spence, Linear Algebra, Prentice Hall, 2003. 3. J. Hefferon, Linear Algebra, http://joshua.smcvt.edu/linearalgebra/
Quality assurance	
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Macrozoobenthos of the Karst Streams</td></tr>
<tr><td>ID</td><td>PPB266</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Biljana Apostolska</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">– to understand the ecology of freshwaters – to understand the origin of karst rivers
– distribution and karst rivers in Croatia
– abiotic and biotic parameters
– macroinvertebrates and their role in karst rivers – biotic indices
– the protection</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students will be able to:
1. to understand and find a connection between abiotic and biotic parameters with macroinvertebrates in karst rivers
2. to explain the differencies between karst rivers and other freshwaters
3. to explain the longitudinal and seasonal changes in karst rivers
4. to recognise and determine the main groups of macroinvertebrates
5. to explain what are bioindicators
6. how to use biotic indices
7. what are the problems in protection of those habitats</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures: / Seminars:
1. Freshwater habitats – ecology, origin and distribution 2. Abiotic and biotic parameters
3. Freshwater fauna–overwiev
4. Macrozoobenthos
5. Biotic indices
6. Protection</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td colspan="4">☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">– prema pravilniku o studiranju</td></tr>
</table>

Monitoring student work	Class attendance		Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	1		
	Colloquiums		Oral exam	1		
	Written exam		Project			
Assessment and evaluation of student work	Oral exam and seminar presentation					

Required literature	Title	Number of copies available	Availability on other medium
	Paul S. Giller and Björn Malmqvist (1999) The Biology of Streams and Rivers		
	Ivo Matoničkin, Zlatko Pavletić (1972) ŽIVOT NAŠIH RIJEKA: Biologija tekućih voda		
	Campaioli, S., Ghetti, P.F., Minelli, A., Ruffo, S. (1994): Manuale per il riconoscimento dei macroinvertebrati delle acque dolci Italiane. Von Trento. Vol. I		
	Campaioli, S., Ghetti, P.F., Minelli, A., Ruffo, S. (1999): Manuale per il riconoscimento dei macroinvertebrati delle acque dolci Italiane. Von Trento. Vol. II		
	Erben, R., Leiner, S. (1997): Vode tekućice i njihov živi svijet II. Hrvatska vodoprivreda.		
	Giller P. S., Malmquist, B. (1998): The biology of streams and rivers. Oxford University Press, Oxford.		
	Kerovec, M. (1986): Priručnik za upoznavanje beskralježnjaka naših potoka i rijeka. Sveučilišna naklada Liber, Zagreb.		

Supplementary literature	Štambuk – Giljanović, N. (2002): Vode Cetine i njezina poriječja. Zavod za javno zdravstvo Splitsko – dalmatinske županije, Split. Tedeschi, S. (1997): Zaštita voda. Sveučilišna tiskara, Zagreb
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Mathematical analysis in R^n I</td></tr>
<tr><td>ID</td><td>PMM157</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Nikola Koceić-Bilan</td><td>Points value (ECTS)</td><td colspan="4">7.5</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>45</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Cilj predmeta je da studenti:
-usvoje osnovna znanja o topološkoj, metričkoj i vektorskoj strukturi n□dimenzionalnog euklidskog prostora Rn
-upoznaju pojmove nutrine, zatvarača, povezanosti, putovima povezanosti, kompaktnosti u Rn
-nauče pojam neprekidnosti, uniformne neprekidnosti i limesa funkcija između općenitijih struktura (metričkih i topoloških prostora) s naglaskom i primjenama na preslikavanja euklidskih prostora i vektorske funkcije
-usvoje konvergenciju nizova točaka u općenitijim strukturama s naglaskom i primjenama na Rn
-upoznaju pojam (uniformne) konvergencije niza funkcija
-usvoje pojam diferencijabilnosti funkcija koje operiraju između euklidskih prostora
-nauče određivati diferencijal funkcije matričnim zapisom linearnog operatora
-uspostaviti vezu između diferencijabilnosti skalarnih funkcija i njezinih parcijalnih derivacija i derivacija duž vektora
-primjenjuju osnovne teoreme diferencijalnog računa funkcija
-usvoje pojam neprekidne diferencijabilnosti i karakterizacije toga pojma
-usvoje pojam diferencijala višeg reda vektorskih funkcija
-nauče promatrati diferencijale viših redova skalarnih funkcija kao n-arne forme s primjenom na Taylorovu formulu
-nauče ispitivati i određivati lokalne ekstreme skalarnih funkcija pomoću njezinih diferencijala i parcijalnih derivacija</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Odslušani i položeni kolegiji: Uvod u matematičku analizu, Diferencijalni i integralni račun I, Linearna algebra II</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Od studenata/ica se nakon položenog kolegija očekuje da budu sposobni:
-opisati topološku, metričku i vektorsku strukturu n-dimenzionalnog euklidskog prostora i objasniti pojmove gomilišta, nutrine, zatvarača skupa, povezanosti, povezanosti putovima i kompaktnosti
-razlikovati neprekidnost i uniformnu neprekidnost preslikavanja potprostora</td></tr>
</table>

	euklidskih prostora -pronaći limese i gomilišta nizova u euklidskom prostoru -karakterizirati temeljne pojmove matematičke analize pomoću nizovne konvergencije -računati limese skalarnih i vektorskih funkcija -razlikovati točkovnu i uniformnu konvergenciju niza funkcija -ispitati diferencijabilnost i neprekidnu diferencijabilnost vektorskih funkcija od više varijabli -odrediti diferencijale svih redova preslikavanja f:Rm->Rn matričnim zapisom linearnog operatora pomoću parcijalnih derivacija i derivacija duž vektora -primijeniti teoreme diferencijalnog računa funkcija f:Rm->Rn -odrediti lokalne ekstreme skalarnih funkcija
Syllabus	-Različite norme i inducirane metrike na Rn .(1 P) (1 V) -Topološka struktura euklidskog n-dimenzionalnog prostora. Topološki prostor i potprostor.(1 P) (1 V) Gomilište skupa. Nutrina i zatvarač. Povezanost. Kompaktnost. (3 P) (3 V) -Neprekidnost funkcija između različitih euklidskih potprostora Rn te između općenitijih metričkih i topoloških struktura (2 P) (3 V) -Vektorski prostor neprekidnih funkcija C(Rm,Rn). (2 P) (2 V) -Homeomorfizam. Povezanost putovima. (1 P) (2 V) -Invarijante neprekidnih preslikavanja. Neprekidnost na povezanim i kompaktnim prostorima. Teorem o međuvrijednostima (1 P) (1 V) -Uniformna neprekidnost. Lipshitzovo svojstvo. (3 P) (3 V) -Prostor linearnih operatora (1 P) (1 V) -Limes funkcija (3 P) (5 V) -Konvergencija nizova u euklidskom, metričkom i topološkom prostoru (2 P) (4 V) -Karakterizacija zatvorenosti i neprekidnosti u metričkim i euklidskim prostorima pomoću konvergencije. (1 P) (1 V) -Gomilišta i podnizovi nizova u euklidskom prostoru. Bolzano-Weirstrassov teorem (1 P) (2 V) -Točkovna i uniformna konvergencija nizova funkcija (1 P) (1 V) -Diferencijabilnost funkcija f:Rm->Rn . (1 P) (2 V) -Derivacije duž vektora i parcijalne derivacije. Gradijent (1 P) (3 V) -Diferencijal skalarnih i vektorskih funkcija. Matrični zapisi diferencijala (2 P) (2 V)

	–Svojstva diferencijala (1 P) (1 V) –Teorem o diferencijabilnosti kompozicije i primjene. Tangencijalna ravnina (2 P) (4 V) –Neprekidna diferencijabilnost. Karakterizacija funkcija klase C1 (2 P) (1 V) –Teoremi diferencijabilnog računa funkcija f:Rm–>Rn (teoremi o srednjoj vrijednosti, teoremi o implicitno zadanoj funkciji). (5 P) (4 V) –Difeomorfizam. Teorem o inverznom preslikavanju. (2 P) (3 V) –Diferencijali viših redova. Kvadratne i n–arne forme (2) (2 V) –Taylorov teorem (2 P) (2 V) –Lokalni ekstremi. Uvjetni ekstrem (2 P) (6 V)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Pohađanje nastave. Obavezna je nazočnost na barem 70% predavanja i vježbi.

Monitoring student work						
Class attendance	2.5	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam	2.5		
Written exam	2.5	Project			

Assessment and evaluation of student work	Ispit na kojem se rješavaju praktični i teorijski zadatci polaže se pismeno. Položeni pismeni ispit je uvjet za pristupanje usmenom ispitu. Pismeni ispit može se položiti i putem dvaju kolokvija tijekom nastave. Konačna ocjena se formira kao aritmetička sredina ocjene na pismenom dijelu ispita i ocjene na usmenom dijelu ispita. U slučaju neuspjeha na usmenom ispitu student ne mora ponovno pristupiti pismenom ispitu da bi stekao pravo (ponovnog) pristupa usmenome ispitu.

Required literature	Title	Number of copies available	Availability on other medium
	N.Koceić Bilan, Osnove matematičke analize I, PMF, Split		
	Š. Ungar, Matematička analiza u Rn , Tehnička knjiga, Zagreb, 2003.		

Supplementary literature	N. Uglešić, Matematička analiza II, Matematička anliza III, W. Rudin, Principles of Mathematical Analysis, Mc-Graw Hill, New York, 1964.
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Mathematical Logic</td></tr>
<tr><td>ID</td><td>PMM110</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Milica Klaričić Bakula</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Students will:
– learn basic concepts and results in Mathematical Logic
– gain a deeper insight in foundations of mathematics
– learn to write complete, coherent, concise proofs demonstrating mathematical rigor using various techniques: directly, indirectly and by induction
– learn how to define a first order theory axiomatically which will give them a good preparation for Set Theory and Geometry.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Entry competences: elementary set theory.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon successful completion of this course students will be able to:

– evaluate the development of Mathematical Logic in terms of its relation to the foundations of Mathematics
– define syntax and semantics of Propositional Logic
– define axiomatically Propositional Logic (Propositional Calculus PC and Deductive Calculus DC)
– state the following metatheorems, give their proofs and explain their meaning for PC and DC: The Soundness Theorem, The Completeness Theorem, The Compactness Theorem, The Deduction Theorem
– define first order theories and explain the position of First Order Logic among them
– define axiomatically First Order Logic (Predicate Calculus PC)
– state the following metatheorems, give their proofs and explain their meaning for first order theories : The Soundness Theorem, The Completeness Theorem, The Compactness Theorem, The Deduction Theorem
– using resolution or tableau test satisfiability, validity and logical consequence
– for a formula find its prenex normal form, disjunctive normal form and conjunctive normal form
– give a formal proof of a formula within a calculus (PC or PD)
– give some well-known examples of first order theories (theory with equality, Peano Arithmetic, Set Theory)</td></tr>
<tr><td>Syllabus</td><td colspan="6">– Introduction: historical overview (1)
– Propositional Logic: syntax and semantics (2)
– Normal forms (2)
– Validity tests (1)
– Propositional Calculus (2)</td></tr>
</table>

	– Metatheorems for PC (2) – The Completeness Theorem and consequences (2) – Deductive Calculus (3) – Alternative axiomatizations and some non-classical propositional logics (1) – First order theories. syntax and semantics (3) – Prenex normal form (1) – Tableau (2) – Predicate Calculus (1) – Metatheorems for first order theories (2) – The Completeness Theorem and consequences (1) – First order theories: examples (4)

Teaching types	[x] Lectures [ ] Seminars [x] Exercises [ ] Fully online [ ] Combined online	[ ] Fieldwork [x] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring	[x] problem sets [ ] [ ] [ ]
Student obligations	Lectures and exercises.		

Monitoring student work						
	Class attendance	2	Research		Practical work	
	Experimental work		Paper		problem sets	0.5
	Essay		Seminar paper			
	Colloquiums	1.5	Oral exam	1		
	Written exam		Project			

Assessment and evaluation of student work

Two partial written exams / one final written exam and final oral exam.

Continuous assessment		
Evaluation elements	Performance (min)	Weight in grade (%)
problem sets	50	10
partial written exams	50	50

Final assessment		
Evaluation elements	Performance (min)	Weight in grade (%)
oral exam	50	40

Required literature	Title	Number of copies available	Availability on other medium
	M. Vuković, Matematička logika 1, PMF, Zagreb, 2007.	10	e-learning
Supplementary literature	1. D. van Dalen, Logic and Structures, Springer-Verlag, 1997. 2. H. D. Ebinghaus, J. Flum, W. Thomas, Mathematical Logic, Springer-Verlag, 1984. 3. A. G. Hamilton, Logic for Mathematicians, Cambridge University Press, 1988. 4. E. Mendelson, Introduction to Mathematical Logic, D. Van Nostrand Company, Inc. Princeton, 1997.		
	5. J. R. Shoenfield, Mathematical Logic, Addison-Wesley, Massachusetts, 1973.		
Quality assurance	Summary feedback for the whole class after the exam. Anonymous student surveyniversity of Split		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Mathematical theory of Computation</td></tr>
<tr><td>ID</td><td>PMM612</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Milica Klaričić Bakula</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">25%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The aim of this course is to introduce basic concepts and results in theory of computation, in particular the theory of formal languages, automata theory, and computability. To conduct a rigorous study of computation, computer scientists work with a mathematical abstraction of computers called a model of computation. There are several models, but the most common is the Turing machine. Students should make a connection between the intuitive concept of the algorithm and the Church-Turing thesis and its consequences. What makes one problem computationally complex and another problem simple? We cannot answer this question, but students should be able to classify computational problems according to their complexity. Closely related to the notion of complexity is the notion of decidability: students learn to distinguish decidable problems from undecidable ones. By the end of this course, students should be able to understand the meaning of Hilbert's tenth problem and the idea of proving Gödel's incompleteness theorems.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Enrolment requirements: Mathematical Logic.
Entry competences: sets and relations; functions; axiomatic set theory; mathematical proofs (in particular proofs by various types of induction); first order theories, first order logic.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon successful completion of this course, students will be able to:
- construct FA that recognizes a given language or grammar, and formulate a regular expression that describes the language recognized by a given FA
- construct a PDA that recognizes a given CF language
- decide if a language is regular or CF
- construct a Turing machine that accepts/decides a language or compute a function
- for a given grammar (RLG, CF, CS) find the language it produces and vice versa
- differentiate decidable from undecidable problems
- prove undecidability by reduction
- prove that a function is recursive or primitive recursive
- define and explain the time complexity of Turing machines, the complexity classes P and NP, and NP-completeness
- prove NP-completeness by reduction</td></tr>
<tr><td>Syllabus</td><td colspan="6">- Partial orders. Complete partial orders. Fixed Point Theorem (2)
- Deterministic finite automata (DFA) and their languages (2)
- Non-deterministic finite automata (NFA) and their languages; Equivalence of DFA and NFA (2)</td></tr>
</table>

- NFA with empty transitions (1)
- Regular languages (RL). Pumping Lemma (2)
- Class RL. RL= FAL (2)
- Decision algorithms for RL (1)
- Minimization of FA (1)
- Context-free languages. Class KFL (1)
- Pumping Lemma for KFL (1)
- Right-linear languages. Class RLL (2)
- RLL = RL (1)
- Algebraic laws for regular expressions (2)
- Push-down automata (PDA) (2)
- Turing machine (TM): motivation, informal and formal definition, TM languages (2)
- Variants of Turing machines and their equivalence (4)
- Informal and formal definition of algorithm, Church-Turing thesis (1)
- Recursively enumerable languages, recursive languages (2)
- Unrestricted grammars, context-sensitive grammars(2)
- Decision problems, important undecidable problems (4)
- Primitive recursive functions, recursive functions (4)
- Computable functions vs recursive functions (2)
- Complexity classes P and NP (2)

Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring	☑ Problem sets ☐ ☐ ☐
Student obligations	Attending classes with active participation in problem sessions. Individual work on exercises, in addition to group work in class, is essential for understanding the material.		

Monitoring student work

Class attendance	2.5	Research		Practical work	
Experimental work		Paper		Problem sets	0.5
Essay		Seminar paper			
Colloquiums	1.5	Oral exam	1.5		
Written exam		Project			

Assessment and evaluation of student work

Final written exam (or two partial exams), and final oral exam: equally evaluated in the final grade. Problem sets.

Continuous assessment

	<table><tr><td>Evaluation elements</td><td>Performance (min)</td><td>Weight in grade (%)</td></tr><tr><td>partial written exams</td><td>50</td><td>50</td></tr><tr><td>problem sets</td><td>50</td><td>20</td></tr></table> <table><tr><td colspan="3">Final assessment</td></tr><tr><td>Evaluation elements</td><td>Performance (min)</td><td>Weight in grade (%)</td></tr><tr><td>oral exam</td><td>50</td><td>30</td></tr></table>
Required literature	<table><tr><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr><tr><td>J. Martin, Introduction to Languages and the Theory of Computation, McGraw Hill, 2010</td><td></td><td>e-learning</td></tr><tr><td>M. Sipser, Introduction to the Theory of Computation, PWS Publishing Company, 1996.</td><td></td><td>e-learning</td></tr></table>
Supplementary literature	1. J. E. Hopcroft, R. Motwani, J. D. Ullman, Introduction to Automata Theory, Languages and Computation, Addison Wesley 2001.. 2. K. R. Apt, E. R. Olderog, Verification of Sequential and Concurrent Programs, Springer 1991. 3. Moll, Arbib and Kfoury, Introduction to Formal Language Theory, Springer 1988.
Quality assurance	Summary feedback for the whole class after the exam. Anonymous student survey.
Other (in the opinion of the proponent)	

Subject name	Mathematical methods of physics I						
ID	PMP107	Study year	2.				
Lecturer	izv. prof. dr. sc. Bernarda Lovrinčević	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			45	15	30	0	
Subject status	Compulsory	Online percentage	10%				
Subject description							
Subject goals	To teach students to use methods of vector and tensor analysis as well as probability and statistics in analysis and solving of physics problems.						
Enrolment requirements	Calculus in one variable						
Learning outcomes	1. Formulate the action of differential vector operator nabla on scalar and vector fields in any orthogonal coordinate system and discuss the interpretation of obtained quantities in physical systems. 2. Choose optimal procedure when calculating physical quantities (using Gauss's, Stokes' and Green's theorem, directional derivative and mathematical identities) 3. Formulate basic operators and theorems of tensor analysis and apply them in different areas, such as mechanics or electrodynamics 4. Apply basic concepts of probability theory and use permutations, combinations and variations in calculations. 5. Calculate basic statistical parameters of a series of data (mean value, standard deviation, estimation of errors), recognise when it is possible to fit data using least squares method and use the calculation of correlations in statistical analysis. 6. Describe properties of discrete and continuous random variables. 7. Enumerate basic methods for parameter estimation, define likelihood function and apply hypothesis testing (e.g. chi-square test).						
Syllabus	1. Curved coordinates. Gradient. Directional derivative. (5h) 2. Divergence. Curl. (6h) 3. Vector integration. Gauss's Theorem. Stokes Theorem. (6h) 4. Gauss's law and Poisson's Equation. Multiple applications of nabla (6h) 5. Dirac Delta Function. (6h) 6. Differential Vector Operators in orthogonal coordinates. Examples in spherical and cilindrical coordinates. (6h) 7. Introduction to Tensor Analysis. Contraction and direct product. Quotient Rule. (8h) 8. Tensors in general coordinates. Covariant derivatives. (8h) 9. Basics in combinatorics. (6h) 10. Elements of the probability theory: random events, dependence and independence. (6h) 11. Random variables and probability distributions (10h) 12. Basic statistical parameters of data series. Propagation of errors. Least squares method. (7h)						

<table>
<tr><td></td><td colspan="6">13. Statistical estimation of parameters. Testing statistical hypothesis. (10h)</td></tr>
<tr><td>Teaching types</td><td colspan="6">☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online
☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring
☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Active participation during class attendance.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>3</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td>Independent work and exam</td><td>3</td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Colloquia and final exam.</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">1. L. Vranješ Makrić, Skripta iz matematičkih metoda fizike I, lecture notes, 2009. Moodle Web page</td><td></td><td>yes</td></tr>
<tr><td colspan="4">2. PP Presentations in probability and statistics</td><td></td><td>yes</td></tr>
<tr><td>Supplementary literature</td><td colspan="6">1. K. F. Riley, M. P.Hobson, S. J. Bence, Mathematical methods for physics and engeneering.
2. H. J. Weber , G. B. Arfken, G. Arfken, Essential Mathematical Methods for Physicists, Academic Press, 2003.</td></tr>
<tr><td>Quality assurance</td><td colspan="6">– following the success of students in colloquia and exam
– following the student success in the following exams and the connection to the success of this course
– student surveys</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">Mathematical Methods of Physics II</td></tr>
<tr><td>ID</td><td>PMP101</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Željana Bonačić Lošić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The understanding and the ability to apply appropriate mathematical methods to analyze and solve physical problems.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Mathematics I and Mathematics II.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Derive and integrate functions of a complex variable.
2. Expand complex functions in series, which includes Taylor series, analytical extension of a function, analysis of poles of a function and Laurent series.
3. Derive the theorem of residues and apply it to solving the integrals in
real and complex area using different forms of integration curves.
4. Calculate the sum of the series using integration in the complex domain.
5. Define the gamma function, connect it with frequently used distributions in physics and apply it in other practical calculations.
6. Expand the periodic function into a Fourier series and add the Fourier series.
7. Use integral transformations such as Fourier, Laplace and
others, when solving physical problems.
8. In practical calculations, use the delta function in one and more
dimension, and with a simple and complex argument.
9. Explain the origin and characteristics of chaotic behavior of dynamic systems.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Functions of a complex variable (5 hours).
Cauchy -Riemann Conditions (5 hours).
Analytic Functions (5 hours).
Cauchy's Integral Theorem (5 hours).
Cauchy's Integral Formula (5 hours).
Laurent Expansion (5 hours).
Singularities (5 hours).
Calculus of Residues (5 hours).
Evaluation of Definite Integrals (12 hours).
Fourier series (10 hours).
Fourier transformation (10 hours).
Introduction to Nonlinear Methods and Chaos. Logistic map. Sensitivity to Initial Conditions and Parameters (3 hours).</td></tr>
</table>

Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☑ Frontal lectures using interactive simulations and computing examples. Problem solving analytically and with computer in exercise classes. Giving problems to students for home exercise. ☐ ☐ ☐

Student obligations	Attendance at lectures and exercises and activity during classes. Solving homework. Going to written and oral colloquiums. Taking the written and oral part of the exam.

Monitoring student work	Class attendance	2.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	2		
	Written exam	1.5	Project			

Assessment and evaluation of student work	The final grade is the average of the grades from the written and oral parts of the exam. Students can pass the written and oral part of the exam through several colloquia during the semester.

Required literature	Title	Number of copies	Availability on other medium

		available	
	1. H. J. Weber , G. B. Arfken, G. Arfken, Essential Mathematical Methods for Physicists, Academic Press, 2003.	1	on-line
	2. G. B. Arfken, H. J. Weber, Mathematical Methods for Physicists, Academic Press, 2005.	2	on-line
Supplementary literature	1. K. F. Riley, M. P. Hobson, S. J. Bence, Mathematical methods for physics and engeneering, Cambridge University Press, 2006. 2. E. Butkov, Mathematical physics, Addison - Wesley Publishing Company Inc., 1968.		
Quality assurance	Student surveys.		
Other (in the opinion of the proponent)			

Subject name	Mathematical Methods of Physics III		
ID	PMP102	Study year	3.
Lecturer	izv. prof. dr. sc. Petar Stipanović izv. prof. dr. sc. Larisa Zoranić	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 30, P: 0
Subject status	Compulsory	Online percentage	10%
Subject description			
Subject goals	Knowledge and skills in the numerical methods and their implementation, including the methods of linear algebra and numerical analysis, applied in solving problems in physics.		
Enrolment requirements	Basic knowledge of programming (C or C++), mathematical analysis, linear algebra and general physics.		
Learning outcomes	1. Apply numerical methods to obtain approximate solutions to mathematical problems such as interpolation, differentiation and integration. 2. Develop a critical understanding of the capabilities and limits of the various numerical methods and correctly estimate numerical errors. 3. Solve ordinary and partial differential equations frequently encountered in physics in some simple cases. 4. Formulate, computationally solve and present results for simple problems in physics.		
Syllabus	Practical exercises on the computer follow lectures with the same schedule according to the following content with applications in physics. INTRODUCTION TO NUMERICAL METHODS (2h) Introduction to the course. Reminder of programming basics: recursive relations, numerical errors. (2h) Solving a system of homogeneous linear equations by the method of Gauss-Jordan elimination with pivoting. Three-diagonal system of linear equations. (2h) Numerical derivation. (2h) Root-finding algorithms: bisection method and Newton-Raphson method. APPROXIMATION AND INTERPOLATION (2h) Approximations and polynomial interpolation. Lagrange interpolating polynomial. (2h) Neville's algorithm. (2h) Cubic spline interpolation. NUMERICAL INTEGRATION (2h) Newton-Cotes quadrature. Equally spaced points. Trapezoidal rule. Simpson's rule. (2h) Gauss-Legend quadrature. Legendre polynomials. Laguerre polynomials. Hermite polynomials. ORDINARY DIFFERENTIAL EQUATIONS (1h) Introduction to differential equations. Numerical solution of motion equations. (1h) Euler's method. Predictor-corrector method. Visualization.		

	(2h) Runge-Kutta method. Harmonic oscillations. PARTIAL DIFFERENTIAL EQUATIONS (4h) Explicit and implicit scheme. 1D diffusion equation. (2h) Crank-Nicolson method. Wave equation. (2h) Elective topic. Project tasks.					
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations	Active participation in classes and assignments. Solving given physics problems and project and its presentation.					
Monitoring student work	Class attendance	2	Research		Practical work	1
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	1	Oral exam			
	Written exam		Project	1		
Assessment and evaluation of student work	The conditions for passing the exam are: - completed mandatory assignments given during lectures and exercises, - passed colloquia or written exam; while a project is elective for a higher grade. The grade is formed according to the evaluation of the student's activity, the grade of the practical exams and the grade of the project.					

Required literature

Title	Number of copies available	Availability on other medium
[1] Morten Hjorth-Jensen: "Computational Physics", Lecture Notes, University of Oslo, 2007, 2015.		yes
[2] W. H. Press, S. A. Teukolsky, W. T. Vetterling & B. P. Flannery: Numerical Recipes in C / C++, The Art of Scientific Computing, Cambridge, 2002, 2007. University Press		yes
[3] K. Ćosić, P. Marendić: "Naučite programirati uz C++", Element, 2009, 2014.	9	no
[4] Leandra Vranješ Markić: "Matematičke metode fizike I", skripta, PMFST, Split, 2009.		yes

	[5] Digitalni materijali s predavanja (P. Stipanović, L. Zoranić).		yes
Supplementary literature	[6] H. J. Weber , G. B. Arfken, G. Arfken, Essential Mathematical Methods for Physicists, Academic Press, 2003. [7] B. W. Kernighan & D. M. Ritchie "The C programing langauge", Prentice Hall, USA, 1998. [8] Z. Drmač, V. Hari, M. Marušić, M. Rogina, S. Singer & S. Singer: Numerička analiza, skripta, PMF, Zagreb, 2003. [9] Cplusplus.com: "C++ Language", Tutorial, http://www.cplusplus.com/doc/tutorial/ [10] Scientific papers.		
Quality assurance	Lecturers who teach subjects, which have correlated learning outcomes, collaborate and take care of teaching quality. Discussion with students and analyzing their progress in solving problem and project tasks. Statistics of exam results and evaluation of efficacy in accordance with the learning outcomes. Student evaluation by anonymous survey conducted according to the rules of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="3">Mathematical program tools I</td></tr>
<tr><td>ID</td><td>PMM017</td><td>Study year</td><td>3.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Jurica Perić</td><td>Points value (ECTS)</td><td>2.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L | S | E | P
0 | 0 | 30 | 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>0%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Competence in the use of LaTeX. Competence in the use of Maxima.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3"></td></tr>
<tr><td>Learning outcomes</td><td colspan="3">The student is able to:
– prepare the text for reading and printing using LateX
– connect smaller units of the document written in LaTex (main page, a list of figures and tables, contents, chapters) in the final document
– show standard mathematical expressions (matrices, integrals, sums, products, piecewise defined function) using Latex
– prepare a seminar and presentation using Latex
– define basic objects using Maxima (functions, lists, matrices)
– solve mathematics problems using Maxima
– create graphics for functions of two and three variables with the change of features of the graphics using Maxima
– modify algorithms for implementation in Maxima</td></tr>
<tr><td>Syllabus</td><td colspan="3">Introduction to Maxima. – 2 hours
Notation and arithmetic. – 2 hours
Defining functions. – 2 hours
Lists, matrices. – 2 hours
Differential calculus, solving equations. – 2 hours Graphics. – 6 hours
Introduction to Latex. – 1 hour Composing plain text. – 1 hour Environments in LaTeX. Tables. – 2 hours The colors in the text. – 1 hour
Graphics. – 1 hour
Composing mathematical text. – 1 hour
Writing mathematical formulas. Parts of mathematical formulas. – 2 hours Array environment. – 1 hour
The environment for the theorem. – 2 hours
Beamer. – 2 hours</td></tr>
<tr><td>Teaching types</td><td>☐ Lectures</td><td>☐ Fieldwork</td><td>☐</td></tr>
</table>

	☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐
Student obligations	Attendance at 70% of exercises.		

Monitoring student work	Class attendance		Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	During the course students work on the computer is monitored. The exam is taken using a computer and consists of two parts, part for the Latex and part for the Maxima.

Required literature	Title	Number of copies available	Availability on other medium
	–		

Supplementary literature	
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

Subject name	Mathematical program tools II						
ID	PMM018	Study year	3.				
Lecturer	doc. dr. sc. Andrijana Ćurković	Points value (ECTS)	2.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			0	0	30	0	
Subject status	Compulsory	Online percentage	30%				
Subject description							
Subject goals	Competence in the use of Scilab. Competence in the use of Octave.						
Enrolment requirements							
Learning outcomes	The student is able to: define basic objects using Scilab and Octave (functions, lists, matrices) solve mathematical problems using Scilab and Octave create graphics for functions of two and three variables with the change of features of the graphics using Scilab and Octave solve ordinary and partial differential equations using Scilab demonstrate the behavior of mathematical models using simulation in Scilab design animation in Scilab modify algorithms for implementation in Scilab and Octave						
Syllabus	Introduction to Scilab and its possibilities – 2 hours Matrices – 2 hours Graphics – 4 hours First partial exam – 1 hour Functions. Branching instructions. Loops – 2 hours Data types – 2 hours. Second partial exam – 1 hour Differential calculus – 2 hours Differential equations – 2 hours Third partial exam – 2 hours Introduction to Octave and its possibilities – 2 hours Basic data types – 2 hours Functions. Branching instructions. Loops. – 2 hours Fourth partial exam – 1 hour Graphics – 2 hours						

	Fifth partial exam – 1 hour					
Teaching types	☐ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations						
Monitoring student work	Class attendance	0.5	Research		Practical work	1.5
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	During the course students work on the computer is monitored. The exam is taken using a computer and consists of five partial exams during the semester (3 partial exams in Scilab, 2 partial exams in Octave).					
Required literature	Title	Number of copies available		Availability on other medium		
	–					
Supplementary literature						
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split					
Other (in the opinion of the proponent)						

Subject name	Mathematics		
ID	PMMN01	Study year	1.
Lecturer	doc. dr. sc. Tea Martinić Bilać	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 30, P: 0
Subject status	Compulsory	Online percentage	35%
Subject description			
Subject goals	The aim of the course is to introduce students to the basic topics of mathematics, designed for undergraduate students in biology, chemistry and biotechnology. Students will adopt the knowledge and skills in differential and integral calculus and learn how to relate these to practical applications.		
Enrolment requirements	Prerequisites: none Entry competences: Knowledge of secondary school mathematics		
Learning outcomes	Students will be able to: • understand the concepts of limits, continuity, derivatives; • compute the limits and the derivatives of various types of functions; • use the derivative of a function to determine the properties of the graph of the function; • write the equations of the tangent line and the normal line to the curve at a given point; • compute the integrals using basic integration formulas; • solve problems in a range of mathematical applications using the integrals.		
Syllabus	Mathematical notation, the sets of numbers. (2) Real functions, some properties. (3) Review of the basic elementary functions. (2) Sequences and series of real numbers (convergence, limits calculus). (2) The limit and continuity of a real function. (3) Differential calculus (differentiability, derivatives of elementary functions, derivatives of higher orders, the basic theorems of differential calculus). (8) Integral calculus (concept and basic properties of definite and indefinite integrals, the integration of certain classes of functions, the basic theorems of integral calculus, applications of definite integrals, improper integrals). (10)		
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐

<table>
<tr><td>Student obligations</td><td colspan="6">Class attendance. Students are expected to be present at least 70% of classes.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>1</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>2</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">There are 2 partial written exams during the semester and the final exam. Passing both partial exams or the final written exam allows students to take the oral exam. Successfully passing the oral exam leads to a successful completion of the course.</td></tr>
<tr><td rowspan="5">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">P. Javor, Uvod u matematičku analizu, Školska knjiga, Zagreb, 1993.</td><td></td><td></td></tr>
<tr><td colspan="4">Bradić, Pečarić, i ost., Matematika za tehnološke fakultete, Element, Zagreb. 1998.</td><td></td><td></td></tr>
<tr><td colspan="4">P.P. Demidovič, Zadaci i riješeni primjeri iz više matematike, Zagreb, 1990.</td><td></td><td></td></tr>
<tr><td colspan="4">T. Vučičić, Matematika (za biologe,...), skripta, PMF, Split</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">L.D. Hoffmann and G.L. Bradley, Calculus for Business, Economics, and the Social and Life Sciences, The McGraw-Hill Companies, 2000.
N. Uglešić, Viša matematika I i II, skripta, www.pmfst.hr/zavodi/matematika/visa_matematika.pdf
I. Slapničar, Matematika 1, skripta, FESB (2002), http:// lavica.fesb.hr/mat1/</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Anonymous student evaluations according to the regulations of the University of Split and summarizing test results.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

Subject name	MATHEMATICS I					
ID	PMM005	Study year	1.			
Lecturer	dr. sc. Ana Laštre, pred.	Points value (ECTS)	8.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			45	0	45	0
Subject status	Compulsory	Online percentage	0%			
Subject description						
Subject goals	The course objective is to introduce students to the fundamentals of differential and integral calculus of functions of one variable. The emphasis is on intuitive understanding of mathematical concepts and on examples illustrating the theory. By attending tutorial sessions, the student gains sufficient technical skills for solving problems and applying the theory in practice.					
Enrolment requirements	Prerequisites: high school level mathematics.					
Learning outcomes	It is expected that the student will be able to: define the fields of real and complex numbers, explain the principle of mathematical induction, describe the properties of real valued elementary functions, apply differential calculus to study the properties of real valued functions, analize convergence of sequences and series, evaluate indefinite and definite integrals, apply differential and integral calculus to problems in geometry.					
Syllabus	Sets of numbers (2 hours) Real valued functins (2 hours) Elementary functions (2 hours) The limit of a function, continuity, types of discontinuity (2 hours) The derivative of a function and its geometrical meaning (2 hours) Differentiation rules (2 hours) Derivatives of elementary functions (2 hours) The chain rule and derivative of the inverse function (2 hours) Higher order derivatives (2 hours) Implicit differentiation (2 hours) The differential of a function (2 hours) Fundamental theorems of differential calculus (2 hours) Applications of differentiation to sketching the graph of a function (2 hours)					

	Sequences and series of real numbers, tests for convergence of series (3 hours) Taylor series (2 hours) Indefinite integral (2 hours) Integration of elementary functions (2 hours) Techniques of integration (2 hours) Definite integral (2 hours) Newton-Leibniz formula, fundamental theorems of integral calculus (2 hours) Improper integrals (2 hours) Applications of integration (2 hours)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Class attendance and partial written exams.

Monitoring student work

Class attendance	3	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam	2		
Written exam	3	Project			

Assessment and evaluation of student work	Partial written exams and final written and oral exam. Positive grade of the written exam is required to take the oral exam.

Required literature

Title	Number of copies available	Availability on other medium
I. Slapničar, Matematika 1, skripta, FESB, Split, 2002.		http://lavica.fesb.hr/mat1/
I. Slapničar, Matematika 2, skripta, FESB, Split, 2008.		http://lavica.fesb.hr/mat2/
I. Slapničar, J. Barić, M. Ninčević, Matematika 1 - zbirka zadataka, FESB, Split, 2010.		http://lavica.fesb.hr/mat1/

Supplementary literature	P. Javor, Matematička analiza 1, 2. izdanje, Element, Zagreb, 2001. B.P. Demidovič, Zadaci i riješeni primjeri iz više matematike, Tehnička knjiga, Zagreb, 1989.

	N. Uglešić, Viša matematika I i II, skripta, PMF, Split.
Quality assurance	Anonymous student evaluations at the end of semester according to the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Mathematics I</td></tr>
<tr><td>ID</td><td></td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Josipa Barić</td><td>Points value (ECTS)</td><td>7.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 30
S: 0
E: 30
P: 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>30%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Focus on intuitive presentation of mathematical theory and on illustrative examples in order to prepare students for future courses.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Successful students will be able to:
- define and explain real and complex numbers
- explain what mathematical induction is
- describe properties of elementary real functions
- apply differential calculus and explain it
- define integral and apply it
- define sequences and series of real numbers
- work with matrices and explain their basic properties .</td></tr>
<tr><td>Syllabus</td><td colspan="3">Sets, axioms for the real numbers, functions, supremum, infimum, mathematical induction (2)
Sequence, subsequence, sequence limits in R, Cauchy sequence, countability (2)
Function limits in R, continuous functions, basic examples (2)
Differentiability, derivative of a function, rules of computation, continuity and differentiability, implicit differentiation (5)
Higher-order derivatives, basic theorems about differetionation, applications (4)
Indefinite integral, basic rules of integration, integration of elementary functions (4)
Definite integral, Newton-Leibniz formula, , applications (4)
Series of real numbers, convergent series, convergence tests, Taylor series, Fourier series (3)
Matrices, matrix algebra, inverse matrix, rank, determinant, elementary transformations, systems of linear equations, Cramer's rule, singular value decomposition (4)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
</table>

<table>
<tr><td>Student obligations</td><td colspan="6">Students are expected to be present for every lecture and exercise section.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>3</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td>4</td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">During the semester, students will write two tests with practical and theoretical tasks. To successfully meet the requirements of the course students must pass both tests.</td></tr>
<tr><td rowspan="5">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">I. Slapničar, Matematika 1, FESB, Split, 2002.</td><td></td><td>http://lavica.fesb.hr/mat1/</td></tr>
<tr><td colspan="4">I. Slapničar, Matematika 2, FESB, Split, 2002.</td><td></td><td>http://lavica.fesb.hr/mat2/</td></tr>
<tr><td colspan="4">B.P. Demidovič, Zadaci i riješeni primjeri iz više matematike, Tehnička knjiga, Zagreb, 1989.</td><td>9</td><td></td></tr>
<tr><td colspan="4">I. Slapničar, J. Barić, M. Ninčević, Matematika 1 – zbirka zadataka, FESB, Split, 2010.</td><td></td><td>http://lavica.fesb.hr/mat1/</td></tr>
<tr><td>Supplementary literature</td><td colspan="6">K. Horvatić, Linearna algebra, 9. izdanje, Tehnička knjiga, Zagreb, 2004.
N. Uglešić, Viša matematika I i II, skripta, PMF, Split.
Bradič, Pečarić, Matematika za tehnološke fakultete, Element, Zagreb
P.V. Minorski, Zbirka zadataka iz više matematike, Tehnička knjiga, Zagreb,</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Detailed statistics of student results, gathering feedback from students through official questionnaires and lecturer's self-evaluation.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">Materials</td></tr>
<tr><td>ID</td><td>PMT154</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivan Peko</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Adopting basic knowledge of materials for the purpose of education in primary and secondary schools</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Define the types of chemical bonds and crystal systems
2. Explain the process of crystallization and characteristics of individual crystal structures
3. Analyze the basic phase diagrams
4. Define conditions occurrence of certain structural phase Fe-C alloy
5. Characterize polymer, composite and ceramic materials
6. Define the basic procedures of heat treatment of metal materials
7. List the basic properties and areas of application of certain technical materials
8. Explain methods of testing materials
9. Create awareness about the importance of recycling materials, their care, and environmental protection</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Introduction to the course and basic concepts
2. The structure of matter - the amorphous and crystalline structures
3. Crystallization of metals
4. Phase Diagrams
5. Phase diagram Fe-C
6. Iron, steel
7. Non-ferrous metals and alloys
8. Colloquium
9. Non-ferrous metals
10. Polymers
11. Ceramic materials
12. Composite materials, wood and stone
13. Heat treatment of materials
14. Material recycling, disposal of materials
15. Colloquium</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures</td><td colspan="4">☐ Fieldwork</td><td></td></tr>
</table>

	☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐

Student obligations	Class attendance, homework (programs), independent study and literature reading, accessing colloquium and/or written and oral examination.

Monitoring student work						
	Class attendance	2.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	0.5	Oral exam	1		
	Written exam	1	Project			

Assessment and evaluation of student work	Class attendance is registered, but not included in the evaluation. Exam and partial exam consists of a theoretical part and assignments. – Theoretical exam (50%) – Assignments (50%) Passing threshold is 50%.

Required literature	Title	Number of copies available	Availability on other medium
	Materijali – predavanja (interna skripta) Mr.sc. Goran Fučko		
	Deželić R, osnove konstrukcijskih materijala, Fesb, Split		

Supplementary literature	Anzulović B., Materijali, FESB, Split
Quality assurance	Conducting an anonymous student surveys, talk with students, analyses the success of students on tests and exams, self-assessment.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Medical Physics</td></tr>
<tr><td>ID</td><td></td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Damir Kovačić</td><td>Points value (ECTS)</td><td>6.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 45 | S: 5 | E: 10 | P: 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>0%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Predmet nudi uvod u medicinsku fiziku, usredotočujući se na primjenu općih načela fizike u medicini. Prilagođen je studentima diplomskog studija fizike, s ciljem da ih opremi temeljnim razumijevanjem načina primjene fizike i računalnih metoda u medicini i liječenju</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Upisan jedan od Diplomskih studija iz prirodnih znanosti</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">1. Analizirati i sintetizirati temeljna načela fizike koja se primjenjuju u medicini kako bi se ilustrirala njena multifunkcionalna uloga u modernom zdravstvu, uključujući integraciju povijesnih dostignuća i predviđanja budućih inovacija.
2. Primijeniti specijalizirano znanje u području fizike nuklearne medicine, omogućujući kritičku evaluaciju metodologija dozimetrije, strategija zaštite od zračenja i sigurnosnih protokola.
3. Ocijeniti i interpretirati različite modalitete medicinskog oslikavanja, uključujući njihovu tehničku osnovu, kliničku primjenu i doprinos točnoj dijagnozi, s posebnim osvrtom na njihovu efikasnost i sigurnost.
4. Integrirati fizikalne koncepte u razumijevanju neurofizioloških procesa, posebno u kontekstu razvoja i primjene tehnologija za mapiranje i intervenciju u funkcijama mozga.
5. Koristiti napredne računalne tehnike za modeliranje, simulaciju i analizu podataka u medicinskoj fizici, demonstrirajući sposobnost rješavanja složenih problema i donošenja temeljitih znanstveno utemeljenih odluka.
6. Procijeniti nove tehnologije i inovacije u medicinskoj fizici, kritički analizirajući njihov potencijal za unaprjeđenje dijagnostičkih i terapeutskih procedura, uz istovremeno prepoznavanje etičkih i sigurnosnih implikacija.</td></tr>
<tr><td>Syllabus</td><td colspan="3">Modul 1: Uvod u medicinsku fiziku
Pregled medicinske fizike
Uloga medicinskih fizičara u zdravstvu
Povijesne perspektive i budući trendovi

Modul 2: Fizika nuklearne medicine
Radioaktivni raspad, zračenje, međudjelovanje zračenja s tvari, raspršenje
Dozimetrija i mjerenje zračenja, zaštita od zračenja

Modul 3: Medicinsko oslikavanje
Rendgenske snimke kompjutorizirana tomografija (CT)</td></tr>
</table>

	Magnetska rezonancija (MRI) Ultrazvuk Električni potencijali Modul 4: Neurofizika Principi fizike u neuroznanostima Senzorni sustavi – sluh Modul 5:Računalne i numeričke metode u medicinskoj fizici Računalno modeliranje u medicini Računalni vid u medicini Modul 6: Nove tehnologije i inovacije u medicinskoj fizici Medicinska bionika Biomaterijali
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☑ Fieldwork ☑ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Student je dužan pohađati predavanja, seminare i vježbe, s najviše 20% opravdanih izostanaka. Student je dužan napisati seminarski rad po odabranoj temi i izložiti ga u obliku prezentacije pred kolegama i nastavnikom.

Monitoring student work

Class attendance		Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam			
Written exam		Project			

Assessment and evaluation of student work	Ocjena se utvrđuje na temelju ocjena: Seminarskog rada (50% ocjene); Usmene prezentacije (50% ocjene)

Required literature

Title	Number of copies available	Availability on other medium
Ante Šantić (1995.), Biomedicinska elektronika, Školska knjiga, Zagreb		

Supplementary literature	Electric Fields of the Brain: The Neurophysics of EEG by Paul L. Núñez
Quality assurance	Vrednovanje rezultata u skladu s navedenim ishodima učenja • Povratna informacija od studenata putem ankete • Samoevaluacija nastavnika • Institucijske i izvaninstitucijske provjere
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Mechanics</td></tr>
<tr><td>ID</td><td>PMP001</td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Ante Bilušić</td><td>Points value (ECTS)</td><td>9.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 60
S: 15
E: 30
P: 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>20%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Understanding the basics of mechanics.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Completion of four years of secondary school, i.e. graduation at the level 4.2 or higher, and passing examinations in compulsory and elective subjects of the state matriculation examination in accordance with the decisions of the higher education institution directing the studies.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">1. Define basic physical quantities and the corresponding units of measurement based on seven fixed values of natural constants, compare basic and derived and vector and scalar quantities.
2. Interpret the basic concepts of kinematics, especially the concepts of velocity and acceleration, and correctly apply and interpret the graphical representation of physical quantities and their interdependence.
3. Qualitatively and quantitatively analyze and compare different types of motion of a material point and a multibody system using Newton's postulates.
4. Analyze and interpret dynamic quantities (force, work, power, energy) and apply the law of conservation of momentum and the law of conservation of energy.
5. Compare the fundamentals of kinematics and dynamics of a rigid body, specifically analyze the conditions of equilibrium and rotation about fixed axes and the motion of the rigid body.
6. Analyze the motion of various types of harmonic oscillators.
7. Compare inertial and non-inertial systems, derive and apply the equation of motion of a particle in a non-inertial system, and analyze inertial forces in rotating systems.
8. Qualitative and quantitative analysis of the motion of a body in an inverse square force field.
9. Define fundamental concepts and describe phenomena from the field of relativistic mechanics.
10. Derive and describe the Euler equation, the continuity equation, the Bernoulli and Navier-Stokes equations, and explain the difference between laminar and turbulent flow.</td></tr>
<tr><td>Syllabus</td><td colspan="3">Lectures with demonstration experiments:
• (1 hour) Basic concepts of space and time; mathematical reminder of vectors and vector calculus
• Kinematics:
o (2 hours) linear and motion in two and three dimensions
o (2 hours) circular motion
• (1 hour) Aristotle's description of the body motion
• (3 hours) Newton’s laws</td></tr>
</table>

	• (2 hours) Diagram of forces to free body (free fall and the vertical shot, horizontal and motion on the slope). The dynamics of system of the bodies • (2 hours) Dynamics of circular motion • Descriptions of the selected forces in nature: o (3 hours) Gravitational force o (2 hours) Elastic force o (2 hours) Friction • (2 hours) Inertial and non-inertial systems • (2 hours) Rotating non-inertial systems • (2 hours) Work and kinetic energy. Elastic and gravitational potential energy. • (3 hours) Conservative and non-conservative forces. Conservation laws in isolated systems • Collisions: o (1.5 hours) Central elastic collision in laboratory and centre-of-mass systems o (1.5 hours) Non-central elastic collision in laboratory and centre-of-mass systems o (1 hour) Non-elastic central collision in laboratory and centre-of-mass systems • (2 hours) Statics of the rigid body • (2 hours) Steiner theorem. Main axis of the rigid body • (1 hour) Euler's equations • (2 hours) Rotation of the axial symmetric free body • (2 hours) Top motion. Angular momentum conservation law. • (3 hours) Periodic motion without and with damping • (2 hours) Forced pendulum • (1.5 hours) Fluid statics: atmospheric and hydrostatic pressure, buoyancy • Fluid dynamics: o (1 hour) Euler's, continuity, and Bernoulli's equation o (1.5 hours) Navier-Stokes equation. Surface tension. Aerodynamics • Mechanics of the solar system o (1 hour) Motion models of celestial bodies o Kepler's laws o (1 hour) Phenomena caused by the motion of the Earth and the Moon. Cosmic velocities, gravitational slingshot, Lagrange points • Special relativity o (2 hours) Michelson-Morley experiment. Lorentz transformations o (1 hour) Transformation of velocity and acceleration o (2 hours) Relativistic dynamics Exercises: • (2 hours) Vectors • (2 hours) Linear motion

	• (2 hours) Complex motions • (6 hours) Force. Newton’s laws. • (2 hours) Reference systems • (2 hours) Work and energy • (2 hours) Momentum and energy conservation laws • (4 hours) Rigid body mechanics • (2 hours) Periodic motion • (2 hours) Fluid mechanics • (2 hours) Mechanics of the solar system • (2 hours) Special relativity Seminars: • (1 hour) Vectors • (1 hour) Linear motion • (1 hour) Complex motions • (3 hours) Force. Newton’s laws. • (1 hour) Reference systems • (1 hour) Work and energy • (1 hour) Momentum and energy conservation laws • (2 hours) Rigid body mechanics • (1 hour) Periodic motion • (1 hour) Fluid mechanics • (1 hour) Mechanics of the solar system • (1 hour) Special relativity					
Teaching types	[x] Lectures [x] Seminars [ ] Exercises [ ] Fully online [ ] Combined online		[ ] Fieldwork [x] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring		[x] Problems solving [ ] [ ] [ ]	
Student obligations	Solving homework assignments during the semester. Class participation.					
Monitoring student work	Class attendance	3.5	Research		Practical work	
	Experimental work		Paper		Problems solving (homeworks)	1
	Essay		Seminar paper			
	Colloquiums		Oral exam	2.5		
	Written exam	2	Project			

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">Twice during the semester, students take a written pre-exam (first part: kinematics, dynamics, systems of the body, the second part: energy, conservation laws, rigid body, oscillations, fluids). Students that reach more than 50% of possible points were acquitted of taking the written exam and can access the oral exam directly. Furthermore, those students that in the first written pre-exam achieve 50% points or more, can take the oral exam in two parts (first part includes materials to the systems of the body, must be taken immediately after the first written pre-exam). The final grade is based on written (pre-)exam (1/2 of the score) and the oral exam (1/2 of the score).</td></tr>
<tr><td rowspan="5">Required literature</td><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td>Antonije Dulčić: Mehanika, Prirodoslovno-matematički fakultet u Zagrebu, (in Croatian)</td><td>0</td><td>yes (free access)</td></tr>
<tr><td>Halliday, Resnick, Walker: Fundamentals of Physics, John Wiley & Sons, 2003.</td><td>25</td><td>yes</td></tr>
<tr><td>E. Babić, R. Krsnik i M. Očko: Zbirka riješenih zadataka iz fizike, Školska knjiga, Zagreb 2004. (in Croatian)</td><td>10</td><td>no</td></tr>
<tr><td>P. Kulišić, L.Bistričić, D. Horvat, Z. Narančić, T. Petrović i D. Pevec. Riješeni zadaci iz mehanike i topline. Školska knjiga, Zagreb, 2002. (in Croatian)</td><td>5</td><td>no</td></tr>
<tr><td>Supplementary literature</td><td colspan="3">[1] C. Kittel, W.P. Knight i M.A. Ruderman. Mehanika, Berkeleyski tečaj, I dio, Golden Marketig Tehnička knjiga, Zagreb 2003.
[2] R. P. Feynman, R. B. Leighton, M. Sands, The Feynman Lectures on Physics, vol. I, Addison-Wesley, 1978.
[3] I. E. Irodov: Problems in General Physics, Mir Publishers, Moscow</td></tr>
<tr><td>Quality assurance</td><td colspan="3">1. Lecturers who have subjects with correlated learning outcomes work together to ensure quality of learning.
2. Statistics of test scores and assessment of performance in accordance with established learning outcomes.
3. Evaluation of students through an anonymous survey conducted in accordance with the regulations of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="3">Meteorology I</td></tr>
<tr><td>ID</td><td>PMP161</td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Jadranka Šepić</td><td>Points value (ECTS)</td><td>5.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td><table><tr><td>L</td><td>S</td><td>E</td><td>P</td></tr><tr><td>30</td><td>5</td><td>15</td><td>0</td></tr></table></td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>0%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Provide knowledge of basic variables and processes in the atmosphere
Provide knowledge on atmospheric thermodynamic processes
Provide knowledge on equations describing dynamics and states of the atmosphere</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Basics of physics
Basics of mathematics
Basics of fluid mechanics
Basic programming</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Basic knowledge on atmospheric composition and structure
Basic knowledge on relevant variables and processes in the atmosphere
Basic knowledge on thermodynamic of dry and moist air
Basic knowledge on atmospheric stability
Basic knowledge on cloud formation and precipitation
Basic knowledge on fundamental forces acting in the atmosphere
Basic knowledge on basic equations</td></tr>
<tr><td>Syllabus</td><td colspan="3">1. Atmospheric composition and atmospheric basics (2 hours of lectures)
2. Ais pressure; hydrostatic equilibrium (2 hours of lectures)
3. Thermodynamics of unsaturated air (3 hours of lectures)
4. Moisture variables (3 hours of lectures)
5. Thermodynamics of saturated air (4 hours of lectures)
6. Atmospheric stability (3 hours of lectures)
7. Clouds and precipitation (5 hours of lectures)
8. Fundamental forces (4 hours of lectures)
9. Equation of movement, equation of continuity, heat conservation law (4 hours of lectures)
11. Scaling analysis. Geostrophic balance and geostrophic wind (2 hours of lectures)
12. Component equations in other coordinates (2 hours of lectures)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars</td><td>☑ Fieldwork
☐ Individual assignments</td><td>☑ Homework</td></tr>
</table>

	☑ Exercises ☐ Fully online ☐ Combined online	☐ Multimedia ☐ Laboratory ☐ Mentoring	assignments ☐ ☐ ☐
Student obligations	Attend at least 70% of lectures and 70% of exercises.		

Monitoring student work						
	Class attendance	1.5	Research		Practical work	
	Experimental work		Paper		Homework assignments	1
	Essay		Seminar paper			
	Colloquiums		Oral exam	1.5		
	Written exam	1	Project			

Assessment and evaluation of student work	Twice during the semester students take preliminary exams (the first preliminary exam consists of the first eight lessons; and the second one of the last four lessons). Students who acquire more than 50% at preliminary exams are exempt from the written exam. Students receive and submit homework during the course. The final grade is formed based on the written exam (or preliminary exams) (40%), homework (20%) and oral exam (40%).

Required literature	Title	Number of copies available	Availability on other medium
	Roland B. Stull Practical Meteorology - An Algebra-based Survey of Atmospheric Sciencecs	0	da

Supplementary literature	James R. Holton & Gregory J. Hakim An Introduction to Dynamic Meteorology Academic Press, 2013.
Quality assurance	Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Meteorology II</td></tr>
<tr><td>ID</td><td>PMP260</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Jadranka Šepić</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">provide knowledge on dynamical and physical processes in the atmosphere
provide knowledge on general circulation of the atmosphere
provide knowledge on synoptic processes
provide knowledge on fronts and air masses</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Meteorology 1
Introduction to Fluid Mechanics
Programming</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">gaining knowledge on dynamical processes in the atmosphere
gaining knowledge on general circulation of the atmosphere
gaining knowledge on synoptic-scale dynamics
gaining knowledge on fronts and air masses
gaining knowledge on atmospheric waves</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Winds in the atmosphere: geostrophic wind (2 hours of lectures)
2. Gradient wind (2 hours of lectures)
3. Winds in atmospheric boundary layer (2 hours of lectures)
4. Cyclostrophic and gradient wind (2 hours of lectures)
5. General circulation of the atmosphere: surface circulation, upper troposphere circulation, vertical circulation (2 hours of lectures)
6. General circulation of the atmosphere - drivers: differential heating, vertical pressure profiles, hydrostatic thermal circulation (3 hours of lectures)
7. General circulation of the atmosphere: conceptual model (4 hours)
8. Barotropic and baroclinic atmosphere (2 hours of lectures)
9. Rossby waves (2 hours of lectures)
10. Fronts and air masses: genesis and movement (5 hours)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises</td><td>☑ Fieldwork
☐ Individual assignments
☐ Multimedia</td><td colspan="4">☑ Homework assignments</td></tr>
</table>

	Fully online Combined online		Laboratory Mentoring			
Student obligations	Attend at least 70% of lectures and 70% of exercises.					
Monitoring student work	Class attendance	1.5	Research		Practical work	
	Experimental work		Paper			1
	Essay		Seminar paper			
	Colloquiums		Oral exam	1.5		
	Written exam	1	Project			
Assessment and evaluation of student work	Twice during the semester, students take preliminary exams (the first preliminary exam consists of the first six lessons, and the second one of the last seven lessons). Students who acquire more than 50% at preliminary exams are exempt from the written exam. Students receive and submit homework during the course. The final grade is formed based on the written exam (or preliminary exams) (40%), homework (20%), and oral exam (40%).					

Required literature	Title	Number of copies available	Availability on other medium
	James R. Holton & Gregory J. Hakim An Introduction to Dynamic Meteorology Academic Press, 2013.	2	no
	Roland B. Stull Practical Meteorology - An Algebra-based Survey of Atmospheric Sciencecs	0	yes

Supplementary literature	Roland B. Stull An Introduction to Boundary Layer Meteorology Kluwer, 1988.
Quality assurance	Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Chemistry Education I</td></tr>
<tr><td>ID</td><td>PMC210</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>dr. sc. Roko Vladušić, v. pred.</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>30</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The aim of course is to provide opportunities for construction of theoretical and practical knowledge about teaching and learning chemistry. Also, students will be taught how to investigate and recognize the lawfulness of chemistry instruction.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">There are no prerequisites for enrolment in the course; starting competencies are related to the adequate knowledge of chemistry.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students:
– based on historical features of the development of chemistry and chemistry education, will be able to see the importance and necessity of the experimental approach to the chemistry teaching,
– will be able to explain the position of Chemistry Education in the area of Science and Education, as well as the object of its research,
– will be able to analyse the purposefulness and effectiveness of different approaches to teaching and learning chemistry in dependence of the content specifics,
– will be able to safely and properly apply the theoretical knowledge in experiment’s preparation and implementation in the chemistry instruction,
– will be able to analyse students' knowledge regarding to the levels and types of knowledge and
– will be able to explain and organise instruction related to the fundamental chemical laws, theories and concepts, as part of their Pedagogical content knowledge.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. History of Chemistry and Chemistry Education (3 Lectures + 1 Seminar)
2. Presentation of selected content issues in Chemistry Education (1 L + 3 S)
3. The place of Chemistry education in science (4 L)
4. Explanations of fundamental chemical laws (4 S)
5. Sources of knowledge in chemistry instruction (6 L + 4 S)
6. Safety and protection in experimental work (2 L)
7. Strategies, methods and procedures in Chemistry instruction
(4 L + 4 S)
8. Learning outcomes in Chemistry Instruction ((2 L + 4 S)
9. Pedagogical content knowledge (2 L + 6 S)
10. The role of taxonomy of knowledge in Chemical Education in evaluation processes (2 L + 4 S)</td></tr>
</table>

Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☑ Combined online		☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring				☐ ☐ ☐ ☐
Student obligations	To attend laboratory exercises, to design and perform experiments, to develop worksheet for experiment implementation in classroom.						
Monitoring student work	Class attendance	2	Research		Practical work		
	Experimental work		Paper				
	Essay		Seminar paper	0.5			
	Colloquiums		Oral exam	1.5			
	Written exam		Project				
Assessment and evaluation of student work	Individual assignments 20 %, Pre-exam, 20 %, Oral exam 60 %						
Required literature	Title				Number of copies available	Availability on other medium	
	Sikirica, M. (2004). Metodika nastave kemije, Školska knjiga, Zagreb.						
	Mrklić, Ž. (1998). Metodika nastave kemije – sažeci predavanja, (interna skripta), Split.						
Supplementary literature	Chemistry textbooks approved by Ministry of Science, education and sport. Holyman, S. (2006). Teacher's book– GCSE Chemistry, Nelson Thornes Ltd, Cheltenham. Pienta, N. J., Cooper, M., M. and Thomas J. Greenbowe (2005). Chemists' guide to effective teaching, Pearson education, New Jersey. Bucat, B. and Fenshman, P. (1995). Selected papers in chemical education research, IUPAC.						
Quality assurance	Personal consultations, Individual tasks analysis, Internal evaluation of learning outcomes achievement; Institutional evaluation at the end of the semester.						
Other (in the opinion of the proponent)							

<table>
<tr><td>Subject name</td><td colspan="6">Methods of Instructions in Applied Mathematics</td></tr>
<tr><td>ID</td><td>PMM133</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Damir Vukičević</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">5%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The goal of this course is to enable students to successfully plan, organize, realize and evaluate courses in applied mathematics. Particularly, students will learn the basics of descriptive and inferential statistics, and financial mathematics, linar programming - this will cover many topics needed to teach financial mathematic and mathematical economy in secondary schools.
Also, their understanding of the modern world filled with financial topics will be vastly improved. Moreover, students will be enabled to preform statistical research on various real-life topics.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Prerequisites: introductory mathematical course completed.
Required competencies: knowledge of elementary mathematics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Student is able to:
- explain basic statistical methods
- apply basic statistical methods on solving simpler tasks
- envision, develop, and lead simpler statistical research
- discuss applicability of proposed statistical method in a given context
- recommend statistical method for proposed research
- calculate loan rates or accumulation of savings
- compare and recommend the best methods of taking loans or saving
-solve basic problems of linear programming</td></tr>
<tr><td>Syllabus</td><td colspan="6">1st week: Introduction to descriptive statistics
2nd week: Population and variables - population parameters;
3rd week: Standardized variable. Chebyshev's theorem.
4th week: Discrete probability.
5th week: Continuous probability.
6th week: Random variable.
7th week: Correlation.
8th and 9th week: Elements of the inferential statistics. Interplay of probability and statistics. Sampling methods. Estimators. Sampling distributions.
10th week: Confidence intervals for mean, proportion, variance, difference of means and proportions.
11th week: Hypothesis testing, parametric tests, non-parametric tests.</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">12th week: Economic functions. Equilibrium. Elasticity.
13th and 14th week: Calculation of interest rates and loan rates.
15th week: Savings and rents. Basic methods of linear programming</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Lecture attendance.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td>Ispit</td><td>3.5</td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6"></td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">N. Koceić Bilan, Primijenjena statistika</td><td></td><td></td></tr>
<tr><td colspan="4">N. Koceić Bilan, Nastavni materijal iz Osnova financijske matematike</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">B. Šego, Z. Lukač Financijska matematikaA. Šegota: Financijska matematika, Udžbenici Sveučilišta u Rijeci 2012

Financijska matematika, ppt, Ekonomski fakultet Sveučilišta u Zagrebu</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Statistics of exam results and student’s course evaluation (survey according to rules of the University of Split).</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">Research Methodology in Natural Sciences</td></tr>
<tr><td>ID</td><td>PMP104</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Damir Kovačić</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">To familiarize students with research methods in the field of natural sciences.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Enrolled one of the diploma study programs.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. To distinguish between scientific and non-scientific approach to problem solving.
2. To enumerate basic methods of research in the natural sciences.
3. To define steps in setting up scientific research in the natural sciences.
4. To analyze scientific paper.
5. To create structure of the scientific article.
6. To define the methods of scientific communication.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Basic scientific methods and principles.
2. Testability of scientific hypotheses.
3. The differences in the methods and aims of the work with social, technical and natural sciences.
4. Reproducibility, standards, controls, and displays of measurement errors. Iterative cycles of experiments and hypotheses.
5. Science as global process.
6. How to recognize scientific work. The choice of research problem – to be both conservative and revolutionary.
7. How to solve a scientific problem. How to describe the results.
8. How to relieve colleagues that we find the errors. The key role of better communication with colleagues.
9. Impact factor journals. Quotes papers – examples. How to cite references.
10. Science on the Internet – what are the servers.
11. Science in Croatia.
12. Examples of good and bad works.
13. Term papers from this course.
14. The principles of work during graduate / master's and doctoral thesis.
15. Evaluation work.</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☑ Exercises</td><td colspan="2">☐ Fieldwork
☐ Individual assignments
☐ Multimedia</td><td colspan="3">☐
☐
☐</td></tr>
</table>

	Fully online Combined online		Laboratory Mentoring			
Student obligations	The student is required to attend lectures, seminars and exercises, with a maximum of 20% of excused absences. The student is required to write a term paper with the chosen topic and present it in the form of presentation to colleagues and teacher.					
Monitoring student work	Class attendance	2	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	2		
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	The grade is determined based on: - Seminar paper (50% grade) - Oral presentation (50% grade)					
Required literature	Title				Number of copies available	Availability on other medium
	R. N. Giere: Understanding Scientific Reasoning, Thomson-Wadsworth, SAD, 1997. ISBN 0-15-501625-3.					
Supplementary literature	[1] P. D. Leedy I J. E. Ormrod: Practical Research. Planning and Design. Pretince Hall, SAD. 2001. ISBN 0-13-121854-9. [2] R. N. Giere: Understanding Scientific Reasoning, Thomson-Wadsworth, SAD, 1997. ISBN 0-15-501625-3.					
Quality assurance	Evaluation of results in accordance with the determined learning outcomes. Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split. Self-evaluation of teacher. Institutional and non-institutional checks.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">Metric spaces</td></tr>
<tr><td>ID</td><td>PMM601</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Goran Erceg</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The course objective is to introduce students with advanced knowledge of metric spaces applying already known topological concepts and results about topological spaces. A special emphasis is on studying complete metric spaces, function spaces and Banach algebra of continuous real functions on compact space. This gives the basics for more advanced studies in modern functional and numerical analysis.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Successfully completed course: Introduction to topology</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">It is expected that student will
– understand special properties of basic topological concepts (convergence, continuity, compactness) in metric spaces
– understand metric concepts (boundedness, total boundedness, Cauchy sequences, completeness, uniform continuity) and their dependence on metric.
– be able to state and prove standard results regarding (compact, complete) metric spaces and (uniformly) continuous functions
– be able to apply the theory in the course to reason about concrete metric spaces and their properties
– be able to decide whether a simple statement about metric spaces and continuous functions is true, providing a proof or counterexample as appropriate
– develop critical and analytical thinking and demonstrate skills in communicating mathematics orally and in writing</td></tr>
<tr><td>Syllabus</td><td colspan="6">– Metric spaces (6 hours)
Bounded and totally bounded sets in metric space. Metric topology. Metrizability. Metrizability of product space.
– Convergence and continuity (6 hours)
Cauchy and convergent sequences in metric space. Continuous functions between metric spaces. Perfectly normal spaces. Theorem of Vedenisoff. Uniformly continuous functions. Heine-Cantor theorem. Topologically equivalent metrics. Uniformly equivalent metrics. Lipschitz equivalent metrics.
– Function spaces (10 hours)
Pointwise, uniform, and compact convergence. Pointwise convergence topology. Uniform topology. Compact convergence topology. Compact-open topology.
– Completeness (11 hours)
Complete metric spaces. Cantor theorem. Completeness and operations on metric spaces. Banach fixed point theorem. Baire theorem. Uniform boundedness principle. Completion of metric space. Kuratowski embedding theorem. Uniqueness of completion.</td></tr>
</table>

<table>
<tr><td></td><td>– Banach algebra of continuous real functions on compact space (6 hours)
Arzela–Ascoli theorem. Stone–Weierstrass approximation theorem
– Metrization theorems (6 hours)
Urysohn metrization theorem. Nagata–Smirnov metrization theorem. Local metrizability.</td></tr>
<tr><td>Teaching types</td><td><table><tr><td>☑ Lectures
☑ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr></table></td></tr>
<tr><td>Student obligations</td><td>Attendance at lectures, seminars and exercises, written assignments, self-study using required and optional literature</td></tr>
<tr><td>Monitoring student work</td><td><table>
<tr><td>Class attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td>0</td><td>Ispit</td><td>4.5</td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Assessment and evaluation of student work</td><td>IThe exam consists of written and oral part. The oral part comes after positively graded (at least 50%) written part Both parts of the exam are equally evaluated in the final grade</td></tr>
<tr><td>Required literature</td><td><table>
<tr><th>Title</th><th>Number of copies available</th><th>Availability on other medium</th></tr>
<tr><td>J. Munkres, Topology, Pearson Education International, New York, 2000</td><td></td><td>da</td></tr>
<tr><td>S. Shirali, H. Vasudeva, Metric spaces, Springer-Verlag, London 2006.</td><td></td><td>da</td></tr>
<tr><td>S. Mardešić, Matematička analiza u n-dimenzionalnom realnom prostoru I, Školska knjiga, Zagreb, 1974.</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Supplementary literature</td><td>J. Dugundji, Topology, Allyn and Bacon Inc., Boston, 1966.
R. Engelking, General Topology, PNW, Warszawa, 1977</td></tr>
<tr><td>Quality assurance</td><td>Exam statistics and students' quality evaluation through anonymous poles</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="3">Modelling Electromagnetic Phenomena in the Environment</td></tr>
<tr><td>ID</td><td>PMP26E</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Žarko Kovač
prof. dr. sc. Dragan Poljak</td><td>Points value (ECTS)</td><td>6.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 30, S: 20, E: 10, P: 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>0%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">– to enable students to understand and apply the basic principles of numerical modelling of radiation transmission in the environment
– setting and solving simple problems in environmental physics by application of modern numerical methods
– permanent acquisition and deepening of knowledge in the field of numerical modelling</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">– Mathematical Methods of Physics 3
– Electrodynamics I
– Electrodynamics II
– Ocean Physics I
– Meteorology I
– programing</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">– understanding and application of basic principles of numerical modelling of electromagnetic phenomena in environmental physics
– setting up and solving simple problems of radiation transmission in environmental physics
– acquiring basic knowledge about solar radiation
– a mathematical description of the propagation of light through the atmosphere and the sea
– knowledge of modelling the greenhouse effect
– acquiring introductory knowledge about the interaction of light and the biosphere</td></tr>
<tr><td>Syllabus</td><td colspan="3">1. Introduction to numerical modelling and classification of numerical methods, and analysis in frequency and time range (2 hours of lectures)
2. Finite difference method (4 hours of lectures and 2 hours of exercises)
3. Finite element method (4 hours of lectures and 2 hours of exercises)
4. Final volume method (4 hours of lectures and 2 hours of exercises)
5. Application of numerical methods to classical electrodynamics and thermodynamics (2 hours of lectures and 4 hours of exercises)
6. Defining the topic of the seminar paper (10 hours of the seminar)
7. Introduction to the theory of radiation transfer (2 hours of lectures)
8. Black body radiation and solar radiation (2 hours of lectures)</td></tr>
</table>

	9. Atmospheric optics (2 hours of lectures) 10. Ocean optics (2 hours of lectures) 11. Long-wave radiation and the greenhouse effect (2 hours of lectures) 12. Remote sensing (2 hours of lectures) 13. Interaction of light and the biosphere (2 hours of lectures) 14. Presentation of seminar paper (10 hours of seminar)
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring ☑ domaće zadaće ☐ ☐ ☐
Student obligations	Attend at least 70% of lectures and 70% of exercises.

Monitoring student work

Class attendance	1	Research		Practical work	
Experimental work		Paper		Domaće zadaće	1
Essay		Seminar paper	1		
Colloquiums		Oral exam	2		
Written exam	1	Project			

Assessment and evaluation of student work	During the first 7 weeks of classes, students receive 5 homework assignments from the first 6 teaching units. These assignments are handed over at the end of the 8th week of classes. During the next 7 weeks of classes, students receive 5 new homework assignments from the next 5 teaching units. These assignments are handed over at the end of the 15th week of class. Students who submit assignments on time and achieve more than 50% of the possible points are exempted from writing the written part of the exam. Students who do not pass assignments or achieve less than 50% of the possible points must take a written exam. In the first 7 weeks of classes, the teacher gives lectures on possible seminar topics. In the 8th week of classes, students choose the topic of the seminar to be submitted by the end of the semester. Students present the seminar at the end of the semester and submit a written version of the seminar before the exam deadline. The final grade is formed on the basis of homework / exams (1/3 grade), seminars (1/3 grade) and answers to the oral exam (1/3 grade).

Required literature

Title	Number of copies available	Availability on other medium
Howard R. Gordon Physical principles of ocean color remote sensing International ocean color coordinating group, 2019.		

Supplementary literature	Muhammad Iqbal

	An Introduction to solar radiation Elsevier, 1983. John T. O. Kirk Light and photosynthesis in aquatic ecosystems Cambridge Universiy Press, 2011. Dragan Poljak Teorija elektromagnetskih polja s primjenama u inženjerstvu Skolska knjiga, 2014.
Quality assurance	Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.
Other (in the opinion of the proponent)	

Subject name	Environmental Fluid Dynamics						
ID	PMP26D	Study year	2.				
Lecturer	izv. prof. dr. sc. Žarko Kovač	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	20	10	0	
Subject status	Compulsory	Online percentage	0%				
Subject description							
Subject goals	– provide knowledge of differential equations describing fluids in the environment – provide knowledge on methods of temporal integration and spatial discretization of partial differential equations – gain knowledge about analytical solutions of advection and diffusion equations and their application to fluids in the environment – get acquainted with numerical methods for solving advection and diffusion equations – acquire introductory knowledge about turbulence – get acquainted with the models of advection, diffusion and reaction – acquire basic knowledge on modelling biological and chemical interactions that take place in the environment						
Enrolment requirements	– Introduction to Fluid Mechanics – Meteorology I – Ocean Physics I – Meteorology II – Ocean Physics II						
Learning outcomes	– understanding the basic dynamics of fluids in the environment – knowledge of the application of methods of temporal integration and spatial discretization of partial differential equations – knowledge of elementary analytical solutions of advection and diffusion equations – knowledge of solving advection and diffusion equations by numerical methods – application of analytical and numerical methods for solving differential equations which describe fluids in the environment – knowledge of implementing numerical methods via computers – basic knowledge of biological and chemical interactions that take place in the environment and how to model them						
Syllabus	1. Finite differences (2 hours of lectures and 2 hours of seminars) 2. Methods of time integration (4 hours of lectures and 2 hours of exercises) 3. Methods of spatial discretization (2 hours of lectures) 4. Advection equation: analytical approach (2 hours of lectures and 1 hour of exercises) 5. Advection equation: numerical approach (2 hours of lectures and 2 hours of exercises) 6. Defining the subject of the seminar paper (10 hours of the seminar)						

	7. Diffusion equation: analytical approach (2 hours of lectures and 1 hour of exercises) 8. Diffusion equation: numerical approach (2 hours of lectures and 2 hours of exercises) 9. Advection-diffusion equation (2 hours of lectures and 2 hours of exercises) 10. Reynolds averaging (2 hours of lectures) 11. Turbulent advection-diffusion equation (4 hours of lectures) 12. Physical, chemical and biological transformations (4 hours of lectures) 13. Turbulent advection-diffusion-reaction equation (2 hours of lectures) 14. Presentation of the seminar paper (10 hours of seminar)					
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring		☑ domaće zadaće ☐ ☐ ☐	
Student obligations	Attend at least 70% of lectures and 70% of exercises.					
Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper		Domaće zadaće	1
	Essay		Seminar paper	1		
	Colloquiums		Oral exam	2		
	Written exam	1	Project			
Assessment and evaluation of student work	During the first 7 weeks of classes, students receive 5 homework assignments from the first 6 teaching units. These assignments are handed over at the end of the 8th week of classes. During the next 7 weeks of classes, students receive 5 new homework assignments from the last 7 teaching units. These assignments are handed over at the end of the 15th week of class. Students who submit assignments on time and achieve more than 50% of the possible points are exempted from writing the written part of the exam. Students who do not pass assignments or achieve less than 50% of the possible points must take a written exam. In the first 7 weeks of classes, the teacher gives lectures on possible seminar topics. In the 8th week of classes, students choose the topic of the seminar to be submitted by the end of the semester. In the seminar, they analyse the analytical model, discretize the model, and compare analytical and numerical results. Students present the seminar at the end of the semester and submit a written version of the seminar before the exam deadline. The final grade is formed on the basis of homework / exam (1/3 grade), seminar (1/3 grade) and the oral exam (1/3 grade).					
Required literature	Title				Number of copies available	Availability on other medium
	Benoit Cushman-Roisin & Jean-Marie Beckers Introduction to Geophysical Fluid Dynamics:					da

	Physical and Numerical Aspects Academic Press, 2007.		
	James C. McWilliams Fundamentals of geophysical fluid dynamics Cambridge university press, 2006.		da
Supplementary literature	Stanley J. Farlow Partial Differential Equations for Scientists and Engineers Dover Publications, 1993. Stanislaw R. Massel Fluid Mechanics for Marine Ecologists Springer, 1999. Benoit Cushman-Roisin Environmental fluid dynamics URL: http://www.dartmouth.edu/~cushman/books/EFM-old.html Scott A. Socolofsky & Gerhard H. Jirka Environmental fluid dynamics URL: https://ceprofs.civil.tamu.edu/ssocolofsky/OCEN677/book.html		
Quality assurance	Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Modelling and Simulation</td></tr>
<tr><td>ID</td><td>PMII80</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Leandra Vranješ Markić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">50%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">To teach students basic steps in the process of modeling and the applications to
solving simpler problems in physics and other sciences.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Basic knowledge of calculus of one variable.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After the course the student will:
– understand basic steps in the process of modeling
– know how to apply the simulation tools in solving the considered and similar
problems
– be able to visualize and critically evaluate obtained results
– understand basic considered physics concepts and relations</td></tr>
<tr><td>Syllabus</td><td colspan="6">Model classifications.
The modeling process.
Simulation tools.
Modelling rate of change.
Simulation techniques.
Force and motion (falling, bungee jumping, pendulums).
Conservation of energy and momentum.
Rocket motion.
Ideal gas laws and scuba diving.
Unconstrained and constrained growth.
Modeling radioactive decay.
Competition.
Drug dosage.
Electrical circuits.
Spread of disease.
Global warming.
Empirical models.
Stochastic modeling and simulation.</td></tr>
</table>

<table>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Active participation in class.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td>2</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>2</td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Colloquia, practical and theoretical final exam</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Presentations and models, different web pages</td><td></td><td></td></tr>
<tr><td colspan="4">Angela B. Shiflet and George W. Shiflet, Introduction to Computational Science: Modeling and Simulation for the Science</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Halliday, Resnick, Walker: „Fundamentals of physics“</td></tr>
<tr><td>Quality assurance</td><td colspan="6">– following the success of students in colloquia and exams
– following the student success in the following exams and the connection to the success of this course
– student surveys</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

Subject name	Modelling and Simulations of Biomacromolecule		
ID	PMP249	Study year	2.
Lecturer	doc. dr. sc. Željka Sanader Maršić	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 30, P: 0
Subject status	Compulsory	Online percentage	10%
Subject description			
Subject goals	Understanding of the basics of the molecular dynamics and quantum chemical simulations and their application to biologically important systems.		
Enrolment requirements	Basic knowledge of physics, biology, statistical mechanics, thermodynamics, classical and quantum mechanics, basics of programming		
Learning outcomes	On completion of this course a student should be able to: 1. Recognize and discuss scientific ideas in modeling of reality and the importance of modeling in biology and medicine. 2. Understand the theoretical foundations of molecular dynamics methods and quantum-mechanical modeling methods. 3. Know the algorithms and techniques used in modeling biological molecular systems. 4. Independently model, simulate and analyze simple and some of the more complex systems of biomacromolecules by the method of molecular dynamics. 5. Understand the difference between molecular mechanical and quantum mechanical methods 6. Use the density functional theory to determine the most energetically favorable structure and its vibrational and absorption spectra. 7. Model the enzyme using a hybrid quantum mechanical / molecular mechanical method 8. Use visualization programs and show different ways of visualizing proteins		
Syllabus	Weekly curriculum: INTRODUCTION 1. Course presentation; Methods of modeling biomolecules - basic characteristics and essential differences between empirical and quantum mechanical methods; Using the Linux operating system on computer clusters, basic commands, running / monitoring calculations on a computer cluster; 2. Database of three-dimensional structures of macromolecules "Protein Data Bank" (PDB); 3D structure prediction programs; Selected software tools for biomolecule visualization; Gromacs and Gaussian software packages; BASICS OF MD SIMULATIONS 3. Fundamentals of molecular dynamics (MD) method, equations of motion, numerical integrators, thermodynamic and statistical-mechanical basis of MD method, initial conditions in simulations of biological systems; 4. Force fields (classical atomic force fields, coarse-grained models ...), Solvent models; Simulation; Calculation of		

<table>
<tr><td></td><td colspan="3">statical and dynamical quantities
in MD;
MD SIMULATIONS
5. MD simulation of proteins in water; Structural quantity analysis; Visualization of biological systems;
6. MD simulations of complex systems (e.g.: protein and ligand, membrane proteins, protein clustering);
7. Advanced sampling methods: "Umbrella sampling"; BASICS OF QM SIMULATIONS
8. Fundamentals of quantum mechanical (QM) method; Introduction to the theory of density functionals (approximations, Hohenberg - Kohn theorems, self-consistent field ...);
9. Functionals, basis sets; Limitations of the method; QM SIMULATIONS
10. QM simulations of peptides (geometry optimization, vibrational spectra, absorption spectra);
11. QM cluster method; QM/MM SIMULATIONS
12. Hybrid quantum-mechanical / molecular-mechanical methods (QM/MM): "additive and subtractive" approach; Mechanical and electrical embedding; Treating the boundary of the QM and MM parts of the system
13. Modelling of the enzymes using QM/MM method; ELECTIVE TOPICS
14. and 15. Elective topics of interest to students: nonequilibrium MD, simulations in confined spaces, optical properties of organic dyes, making simulation films</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☑ Laboratory
☐ Mentoring</td><td>☑ homework assignment
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Active participation in classes and assignments in class, solving of assignments at home, preparation of seminars that include independent solving of a physical problem, writing reports and presentations of the same.</td></tr>
</table>

Monitoring student work						
Class attendance	2	Research		Practical work	1
Experimental work		Paper		Homework assignments	1
Essay		Seminar paper	1		
Colloquiums		Oral exam			
Written exam		Project			

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">The conditions for passing the exam are: the ability to use existing programs for modelling biomacromolecules. Assessment through computer assisted exercises and seminars. The grade is concluded according to the evaluation of the student's commitment in class and the grade of the seminar.</td></tr>
<tr><td>Required literature</td><td>Title</td><td>Number of copies</td><td>Availability on other medium</td></tr>
</table>

		available	
	Essentials of Computational Chemistry: Theories and Models, Christopher J. Cramer, John Wiley & Sons Ltd, England, 2004		yes
	Molecular Simulations: Fundamentals and Practice, Saman Alavi, Wiley-VCH Verlag GmbH & Co., Germany, 2020		yes
	Understanding Molecular Simulation: From Algorithms to Applications Daan Frenkel and B. Smit, Academic Press, 2001		yes
Supplementary literature	[1] P. Allen & D. Tildesley, Computer Simulation of Liquids, Clarendon, Press, Oxford, 1987. [2] Scientific articles, lectures.		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)			

Subject name	Modern Physics		
ID	PMP008	Study year	2.
Lecturer	izv. prof. dr. sc. Željana Bonačić Lošić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 45, S: 15, E: 30, P: 0
Subject status	Compulsory	Online percentage	0%
Subject description			
Subject goals	Understanding of the basic concepts of modern physics and ability to explain them to others.		
Enrolment requirements	Passed exams in General Physics I, General Physics II, Mathematics I and Mathematics II		
Learning outcomes	1. Explain the difference between the wave and photonic nature of electromagnetic radiation and apply the photon model to the corresponding phenomena (Planck's model thermal radiation, photoelectric effect, Compton effect). 2. Explain the Rutherford model of the atom, explain the quantization of energy in the atom on the example of Bohr's model of the hydrogen atom and explain the operation of the laser and the origin characteristic X-ray spectrum of atoms. 3. Define de Broglie's postulates and uncertainty principles and describe the experiments that confirmed the wave nature of matter. 4. Explain the properties of the Schrodinger equation, analyze quantum-mechanical model of hydrogen atom and spin of electron and explain filling of electron states in multi-electron atoms. 5. Explain the bonding of atoms in covalent and ionic molecules and crystals and analyze electronic, vibrational and rotational spectra of polyatomic molecules. 6. Analyze the difference between metals, semiconductors and insulators using a model of electron bands in solids and explain current conduction in metals and semiconductors. 7. Explain the structure and models of atomic nuclei, explain radioactivity and types of radioactive decay. 8. Describe the spectral types of stars and explain the formation of stars, describe nuclear processes in stars, apply Planck's blackbody model to star radiation. 9. Explain the division of basic forces and the classification of elementary particles, explain basic concepts of cosmology.		
Syllabus	Rutherford scattering and Rutherford model of atom (6h). Planck law of black body radiation (6h). Bohr’s model of hydrogen atom (3h). Franck-Hertz experiment (1h). Photoelectric effect (3h). Compton scattering (3h). De Broglie hypothesis (3h).		

	Davisson–Germerov experiment (1h). Bohr's principle of complementarity and Heisenberg principle of uncertainty (2h). Schrödinger wave equation (6h). Tunnel effect (2h). Harmonic oscillator (2h). Hydrogen atom (3h). Applications of quantum mechanics (6h). Stern Gerlach experiment (4h). Spin (1h). Spectrum of X rays (3h). Quantum structure of atoms, molecules and solids (8h). Atomic nucleus (3h). Radioactivity and types of radiactive decays (6h). Models of atomic nuclei (3h). Fission (1h). Nuclear reactors (1h). Fusion (1h). Elementary particles (3h). Basic forces and their mediators (3h). Expansion of the universe (2h). Background radiation (2h). Big bang and the origin of the universe (2h).		
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☑ Lectures accompanied with experiments. Seminar. Solving problems instructed by assistant. Uninfluenced solving of problems. Check of the solved problems and

							discussion on tutorials.	
Student obligations	Active lectures, seminars and exercises attendance.							
Monitoring student work	Class attendance	3	Research		Practical work			
	Experimental work		Paper					
	Essay		Seminar paper	1				
	Colloquiums		Oral exam	1				
	Written exam	1	Project					
Assessment and evaluation of student work	Preliminary exams. Written exam. Seminar. Oral exams which include all or partially teaching material.							
Required literature	Title					Number of copies available	Availability on other medium	
	1. R. A. Serway, C.J. Moses and C. A. Moyer, Modern Physics, Thomson, Brook/Cole, 2005.					2	on-line	
	2. P. Županović and Ž. Bonačić Lošić: Predavanja iz Moderne fizike, skripta za internu uporabu						E-learning	
Supplementary literature	D. Halliday, R. Resnick and J.Walker, Fundamentals of Physics. John Wiley, New York 2001							
Quality assurance	Student's opinion poll.							
Other (in the opinion of the proponent)								

<table>
<tr><td>Subject name</td><td colspan="6">Molecular Genetics</td></tr>
<tr><td>ID</td><td>PMB545</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivica Šamanić</td><td>Points value (ECTS)</td><td colspan="4">3.5</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The course covers a range of basic topics of molecular genetics including the concept of the gene, transcription, translation, regulation of gene expression and replication. The course takes a genomics centered approach and covers many of the latest methodologies used in genomics analysis. The course also
covers both prokaryotic and eukaryotic systems, taking a historical and methodological approach with the aim of providing insight into how understanding was obtained through experimentation and discovery.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Fundamental knowledge of molecular biology and genetics are required.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">By the end of this course students will be able to:
• explain what genes are and how they function, clarify the mechanisms of information flow, from genes to proteins, and how these processes are regulated
• explain DNA replication in bacteria, plasmids, transposable elements, as well as eukaryotic organelles and the nucleus
• understand the molecular mechanisms related to gene expression at the transcriptional level, with an emphasis on eukaryote
• extract information from genomic databases and perform DNA sequence analyses using online bioinformatics tools.
• critically examine research reports and publications dealing with molecular genomics
• give oral presentation of scientific facts</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures (30 hours)
1. Genome structure and organization; genome size, introns and exons, genome structure of viruses and prokaryotes, genome organization of cellular organelles, organization of nuclear DNA in eukaryotes
2. Genome Replication
3. Operon model for the regulation of gene expression in prokaryotes
4. Eukaryotic Transcriptional and Post-Transcriptional Gene Expression Regulation
5. Functional diversity of RNA; short non-coding RNA (snRNA, snoRNA, scaRNA, tRNA, miRNA, piRNA, siRNA), long non-coding RNA (nuclear lncRNA, cytoplasmic lncRNA)</td></tr>
</table>

	6. Functional genomics; Gene expression at the biochemical, cellular and organism level, Forward Genetics, Reverse Genetics 7. Translation and post-translational modifications 8. Plasmids; F plasmid conjugative DNA transfer, Ti plasmid as a vector for plant transformation 9. Mobile genetic elements; retrotransposons and DNA transposons 10. Comparative genomics; gene duplication, pseudogenes and retrogenes, molecular phylogeny, Orthologous and paralogous genes 11. Next-generation sequencing methods; Sequencing strategies and the shotgun method, Massive parallel sequencing and its applications parallel sequencing, overview of next-generation sequencing platforms 12. Mutations and DNA repair 13. Biological functions of site-specific recombination; prophage insertion (Integration and excision of bacteriophage λ), genetic inversion 14. Methods of modifying genes in eukaryotic cells; Lipofection (or liposome transfection), Precise genome editing by homologous recombination, Genome editing with site-specific nucleases (zinc finger nucleases, TALEN, and CRISPR-Cas systems) 15. Therapeutic genome editing strategies - genetic engineering to cure disease; RNA-based therapeutic, Mitochondrial replacement therapy (MRT) Seminars (15 hrs) Reading and discussing scientific literature, writing a short assay summarizing analyzed articles in the context of the relevant genomic results. It will be additional reading from the sources that the textbook does not cover in sufficient detail since genomics is a rapidly changing field. The aim is to develop writing skills and presentation skills needed to effectively communicate the purpose, scope, and conclusions of the project. Practical application of computers in the analysis of biological data. The computational lab is an essential component of this course where students will be trained to use online tools and databases for sequence alignment, gene expression analysis and genome-scale data.

Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☑ Combined online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☑ Računalna analiza bioloških podataka ☐ ☐ ☐
Student obligations			

Monitoring student work	Class attendance	0.5	Research		Practical work	1
	Experimental work		Paper			
	Essay		Seminar paper	1		

	Colloquiums		Oral exam			
	Written exam	1	Project			

Assessment and evaluation of student work	Methods of Evaluation • Computational tasks – Hands On: Gene Structure/Bioinformatics Project The evaluation of this section is carried out by a practical test at the computer lab. In this exam session, the student must perform bioinformatic analysis of genomic data using web and software based approaches; using bioinformatics tools, students analyze unknown complementary sequence of a DNA molecule (cDNA) and expected to identify the gene and organism to which it belongs. In addition, they will demonstrate the process of aligning multiple DNA sequences using a sequence analysis tool and determine the differences in their sequence. • Research-based class seminar will be elevated. Students will have to prepare presentation showing background of the problem they are dealing with. The presentation will be scored according to the content of the presentation (key words, critical review of literature, presentation of scientific results), format, innovativeness and language competence as well. • Class Participation will also be part of the grade. • Final Lecture Exam: written examination (multiple-choice questions from the presentation material). Final grades will be based on each student's performance as assessed by points total.

Required literature	Title	Number of copies available	Availability on other medium
	Geoffrey M. Cooper, Robert E. Hausman - Stanica_ molekularni pristup-Medicinska naklada (2010)		

Supplementary literature	Strachan, Tom & Read, Andrew - Human Molecular Genetics-Garland Science (2019) Jocelyn E. Krebs, Elliott S. Goldstein, Stephen T. Kilpatrick - Lewin's Genes XII-Jones & Bartlett (2018)
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Advanced Astronomy and Astrophysics</td></tr>
<tr><td>ID</td><td>PMP230</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Koraljka Mužić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>15</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Nakon odslušanog kolegija studenti će biti upoznati sa osnovama teorije potencijala, zvjezdane kinematike i dinamike zvjezdanih sustava, strukturom Mliječne staze te nastankom i evolucijom galaksija.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6"></td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Nakon usvajanja gradiva od studenta se očekuje da zna:
1. osnovne veličine kojima opisujemo zračenje, fizikalna svojstva zvijezda iz opažanja i zvjezdanu klasifikaciju.
2. opisati nastanak linija u zvjezdanim spektrima, Maxwellovu raspodjela brzina, Boltzmannovu i Sahinu jednadzbu;
3. osnovne jednadžbe strukture zvijezda, te izvore energije u zvijezdama.
4. evoluciju zvijezda, sto uključuje ranu evolucija (nastanak zvijezda i dolazak na glavni niz), evoluciju na i nakon glavnog niza.
5. Tipove i klasifikaciju galaksija, te dokaze za postojanje tamne tvari u galaksijama.
6. osnovne metode mjerenja udaljenosti u astronomiji (galaktičke i ekstragalaktičke).
7. Strukturu, kinematiku i dinamiku Mliječne staze;
8. Teorije nastanka i evolucije galaksija.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Makroskopski opis zračenja: intenzitet, tok, luminozitet, tlak zračenja, prividna i apsolutna magnituda.
2. Opažanja zvijezda: zračenje crnog tijela, apsorpcijske i emisijske linije, zvjezdani spektri, Hertzsprung-Russell dijagram. Trigonometrijska paralaksa.
3. Zvjezdane atmosfere: temperature i uvjeti termodinamičke ravnoteže. Maxwellova raspodjela brzina, Sahina i Boltzmannova jednadžba, nastanak linija u zvjezdanim atmosferama. Spektralna klasifikacija.
4. Struktura zvijezda: osnovne jednadžbe (raspodjela mase, hidrostatska ravnoteža, jednadžba prijenosa energije), virijalni teorem. Nuklearne reakcije, fuzioniranje vodika (pp-lanac i CNO ciklus) i drugih elementata. Nukleosinteza.
5. Evolucija zvijezda: rana evolucija (nastanak zvijezda i dolazak na glavni niz), diskusija evolucije zvijezda raznih početnih masa, evolucija nakon glavnog niza; degenerirani ostaci zvijezda: degenerirana materija, bijeli patuljci, neutronske zvijezde;
6. Galaksije: klasifikacija i opažanja. Hubbleova vilica. Fotometrija i profili, te spektri galaksija. Skupovi galaksija.
7. Metode mjerenja udaljenosti: Hubbleov zakon (širenje svemira), relacije Tully-Fisher i Faber-Jackson.
8. Rotacijske krivulje i dokazi za tamnu tvar u galaksijama.
9. Mliječna staza: struktura, kinematika i dinamika (detaljna analiza), zvjezdane populacije.
10. Nastanak i evolucija galaksija: gravitacijska nestabilnost, hijerarhijska teorija nastanka struktura, utjecaj plina.</td></tr>
</table>

Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	Pohađati barem 70% predavanja i 70% vježbi. Izraditi seminarski rad i prezentirati ga.		

Monitoring student work						
	Class attendance		Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	Završna ocjena kolegija sastojat će od: (1) Pismeni ispit ili kolokviji (40%) (2) Usmeni ispit (40%) (3) Seminarski rad i prezentacija (20%)

Required literature	Title	Number of copies available	Availability on other medium
	[1] D. A. Ostlie and B. W. Carrol, “An Introduction to Modern Astrophysics”, 2nd ed. Addison Wesley (2017).		
	[2] P. Schneider, „Extragalactic Astronomy and Cosmology”, Springer (2015).		

Supplementary literature	[1] R. Kippenhahn and A. Weigert, “Stellar Structure and Evolution”, Springer-Verlag, Study edition (August, 1994). [2] C. J. Hansen, S. D Kawaler & V. Trimble, “Stellar Interiors - Physical Principles, Structure, and Evolution”, Springer (2004). [3] Binney & Tremaine, “Galactic Dynamics”, Princeton University Press (1987). [4] Binney and Merrifield, "Galactic Astronomy", Princeton University Press (1988). [5] Sparke and Gallagher, "Galaxies in the Universe", Cambridge University Press.
Quality assurance	Statistika ispitnih rezultata i studentsko evaluiranje putem anonimne ankete na kraju izvedbe predmeta. Anketa se provodi prema pravilniku Sveučilišta u Splitu.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Advanced Electrodynamics</td></tr>
<tr><td>ID</td><td>PMP113</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Petar Stipanović</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>15</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Formulation of the laws of classical and relativistic electrodynamics and special theory of relativity, with the development of mathematical methods and critical judgment of their applicability in selected physical problems.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Prior knowledge of mathematical analysis (differential and integral calculus with functions of several variables) and differential equations is required.
- Mathematical Methods of Physics I (passed)
- Differential Equations (attended)
- Electricity and Magnetism (passed)
- Waves and Optics (attended)
- Classical Electromagnetism (enrolled)</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Formulate basic quantities and laws of classical electrodynamics in vacuum and matter (Maxwell's equations in classical and tensor form, Poynting's vector, Poynting's theorem, Maxwell's tensor, retardation potentials, Jefimenko's equations, Lienard-Wiechert potentials, Larmor's formula, etc.) using vector and tensor analysis and Einstein's convention, when needed and within the framework of the special theory of relativity.
2. Formulate the given problem with differential equations and apply Green's functions in the solution.
3. For the given dynamic charge/current distributions, estimate the electromagnetic potentials and fields, estimate their dis-/continuity at the edge, apply quasi-static approximations if necessary and sketch the dependence of quantities.
4. Chose appropriate conservation laws (charge, energy, momentum) and equivalent quantities to simplify the complex and dynamic distributions of charges and currents.
5. Examine the laws of geometric optics and Fresnel’s equations using Maxwell's equations; construct simple models of wave incidence on a conductor, absorption, dispersion and propagation of electromagnetic waves through the waveguides.
6. Formulate classical electrodynamics using scalar and vector potential, performing gauge transformations and estimating retardation effects.
7. Argue approximations in models of electric/magnetic dipole radiation, of arbitrary charge density, and of a point charge in motion.
8. Formulate space-time transformations for ideal systems in a relatively uniform motion by using Einstein’s postulates of the special theory of relativity; and evaluate their influence on the transformations of electromagnetic</td></tr>
</table>

<table>
<tr><td></td><td>fields.
9. Formulate Maxwell equations in covariant form.</td></tr>
<tr><td>Syllabus</td><td>Seminars and exercises following the lectures in units:
(3h) Maxwell's formulation of classical electrodynamics (Maxwell's equations and boundary conditions, linear and nonlinear matter)
(6h) Conservation laws of charge, energy, momentum (continuity equation, Poynting's vector, Poynting's theorem, Maxwell's tensor)
(12h) Electromagnetic waves (laws of geometrical optics in vacuum and matter, absorption and dispersion, waveguides)
(6h) Potential formulation of classical electrodynamics (gauge transformations of scalar and vector potentials, retarded potentials, Lienard–Wiechart potential, Jefimenko’s equations)
(9h) Radiation (radiation of electric/magnetic dipole, of arbitrary charge density and of point charge in motion)
(9h) Relativistic electrodynamics (special theory of relativity, transformations of mechanical quantities and electromagnetic fields, tensor formulation of classical electrodynamics)</td></tr>
<tr><td>Teaching types</td><td><table><tr><td>☑ Lectures
☑ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☑ Individual assignments
☑ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr></table></td></tr>
<tr><td>Student obligations</td><td>1. Active participation on lectures by giving critical judgment and argumentation of opinions, asking and answering questions.
2. Solve given problems from electromagnetism.
3. Discuss given concepts and laws and their applicability.</td></tr>
<tr><td>Monitoring student work</td><td><table>
<tr><td>Class attendance</td><td>3</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>0.5</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>1.5</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Assessment and evaluation of student work</td><td>The final grade is formed after the student passes both test parts:
written exam (problem solving, 50% rating) and oral exam (theory, 50% rating).
During classes, short tests of learning outcomes are carried out, through which it is possible to be exempted from part of the exam, and colloquia (problems tasks) which are equivalent to the written exams.</td></tr>
<tr><td>Required literature</td><td><table><tr><td>Title</td><td>Number of copies</td><td>Availability on other medium</td></tr></table></td></tr>
</table>

		available	
	[1] David J. Griffiths: Introduction to Electrodynamics, Cambridge University Press, 2017.	13	yes
	[2] I. Supek: Teorijska fizika i struktura materije, Školska knjiga.	11	no
	[3] Lecture notes		yes
Supplementary literature	[4] John David Jackson: Classical electrodynamics, Wiley, New York.		
	[5] Different www-materials from electromagnetism.		
Quality assurance	1. Lecturers who teach subjects, which have correlated learning outcomes, collaborate and take care of teaching quality. 2. Statistics of exam results and evaluation of efficacy in accordance with the learning outcomes. 3. Student evaluation by anonymous survey conducted according to the rules of the University of Split.		
Other (in the opinion of the proponent)			

Subject name	Advanced Quantum Physics		
ID	PMP200	Study year	1.
Lecturer	prof. dr. sc. Leandra Vranješ Markić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 30, S: 15, E: 30, P: 0
Subject status	Compulsory	Online percentage	10%
Subject description			
Subject goals	Extend students' ability in applying the basic formalism of quantum mechanics to understanding and predicting the behavior of physical systems for which the Schrodinger equation cannot be analytically solved, such as multielectron atoms. Understanding and applying interference calculations, solving scattering problems. Introduce students to concepts that will allow them to monitor new results related to the interpretation and modern applications of quantum mechanics.		
Enrolment requirements	Knowledge of basic concepts of quantum mechanics and ability to apply to simple problems and the hydrogen atom.		
Learning outcomes	At the end of the course student should be able to: 1. Apply the appropriate method (time-independent perturbation theory, variational method, WKB method) to approximately determine stationary states and validity limits of obtained solutions. 2. Discuss the pictures of quantum physics (Schroöinger, Heisenberg and Dirac picture). 3. Analyse the time-dependent perturbation theory and apply it in examples with important time-dependent potentials (costant in a time interval, harmonic change, sudden and adiabatic change). 4. Explain the quantisation of electromagnetic field and basics of quantum optics and apply them in simple examles. 5. Discuss main concepts in quantum scattering theory and important approximations and apply them in scattering examples without spin 6. Discuss concepts of identical particles, wave-function symmetry with respect to exchange of the particles, connection between spin and quantum statistics and the role of quantum statistics, especially in the periodic table of elements. 7. Choose appropriate method for approximate determination of the many-particle systems and determine the validity limits of obtained solutions (Hartree-Fock, variational method, molecular dynamics) 8. Apply the methods of quantum physics in description of important many-particle systems, atoms and molecules (helium atom, ions of hydrogen molecule) 9. Explain quantum coupling and measurement problems and modern applications of quantum mechanics: quantum computing, quantum teleportation and quantum cryptography.		
Syllabus	1. Addition of angular moments. 7 hours 2. Time-independent perturbation, non-degenerate and degenerate systems. 8 hours		

	3. Application of perturbation theory: Zeeman effect. Stark effect. Fine and hyperfine structure. 8 hours 4. Variation principle. Application to the helium atom. 4 hours 5. WKB method. 6 hours 6. Pictures of quantum mechanics. Time-dependent perturbation theory and application 8 hours 7. Quantization of electromagnetic filed and selection rules for electromagnetic radiation. 6 hours 7. Scattering theory. Bourne approximation. Partial wave method. 8 hours 8. Multiparticle Schroedinger equation. Wave function of identical particles. 5 hours 9. Multielectron atoms. Helium atom. Periodic table of the elements. 5 hours 10. Hydrogen ion and molecule. Molecular spectra. 4 hours 11. Quantum entanglement. EPR argument. Bell's inequalities. Schroedinger's cat. 3 hours 12. Quantum teleportation. Quantum cryptography. Elements of quantum computing theory. 3 hours					
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations	Active participation in the classes					
Monitoring student work	Class attendance	2.5	Research		Practical work	
	Experimental work		Paper		Independent work	3.5
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">Written exam (or colloquia) and oral.</td></tr>
<tr><td rowspan="4">Required literature</td><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td>[1] N. Zettili, "Quantum mechanics: concepts and applications".</td><td>4</td><td></td></tr>
<tr><td>[2] Various websites with solved examples in quantum mechanics.</td><td>0</td><td></td></tr>
<tr><td>[3] Popular and scientific articles and presentations (quantum coupling, quantum cryptography, teleportation, quantum computing).</td><td>0</td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">1. R. Scherrer „Quantum mechanics: An Accessible Introduction“
2. R. L. Liboff, „Introductory Quantum Mechanics“
3. Auletta, Genaro, Parisi, “QuantumMechanics”
4. D. J. Griffits, “Introduction to QuantumMechanics”</td></tr>
<tr><td>Quality assurance</td><td colspan="3">Monitoring success in colloquia and exams.
Discussion with students and analysing their progress in solving problem and assignments.
Student evaluation by anonymous survey conducted according to the rules of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">Advanced Statistical Physics</td></tr>
<tr><td>ID</td><td>PMP115</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Larisa Zoranić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>15</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">5%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Understanding the behavior of systems of many particles through thermodynamics and statistical physics.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Passed courses in General Physics, Modern Physics, Mathematics and attended introductory courses in statistical physics and classical mechanics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After successfully completing the course, the student will be able to:
1. To connect thermodynamics and statistical physics in order to explain physical phenomena in multiparticle systems.
2. Formulate and apply ensemble theory to various physical systems.
3. Derive Liouville's theorem and discuss the ergodic hypothesis.
4. Analyze the properties of bosonic systems of many particles.
5. Analyze the properties of fermionic systems of many particles.
6. Analyze phase transitions and critical phenomena.
7. Discuss the concept of Brownian motion and diffusion processes.
8. Discuss the interrelationships of fluctuations, dissipation and macroscopic irreversibility.</td></tr>
<tr><td>Syllabus</td><td colspan="6">The timetable worked out according to the weekly plan:
1. Introduction to the course. Statistical ensembles. Density function and probability density. Microcanonical and canonical ensemble. The ergotic hypothesis. Liouville's theorem.
2. Grand canonical ensemble. Canonical potential. Fluctuation of the number of particles. Chemical reactions.
3. Thermodynamic description of classical models (polymer, "zipper" model, two-state model, ideal gas) in different ensembles.
4. Comparison of classical and quantum approaches. Symmetric and antisymmetric states. Factor N! Density of states. Quantum distributions.
5. Fermi-Dirac distribution. An ideal Fermi gas at low temperatures.
6. Fermi energy. Sommerfeld's expansion.
7. Bose-Einstein distribution. An ideal Bose gas.
8. Blackbody radiation through Bose-Einstein statistics. Bose-Einstein condensation.
9. Thermodynamics and statistical mechanics of magnetism.
10. Phase transitions of the first type. Phase stability conditions. Clausius-Clapeyron relation. Phase transitions of another kind. Van der Waals model.
11. Behavior near the critical point. Critical exponents.</td></tr>
</table>

	12. Ising's model. Mean field theory. Scaling. 13. Stochastic processes. Description of Brownian motion and diffusion. Einstein-Smoluchowski equation. 14. Langevin equation. Fokker-Planck equation. 15. Fluctuations and non-equilibrium processes. Fluctuation-dissipation theorem.
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Attendance and commitment of students in class, solving tasks in class and at home. Participation in class discussions and debates.

Monitoring student work

Class attendance	2	Research		Practical work	0.5
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums	1.5	Oral exam	2		
Written exam		Project			

Assessment and evaluation of student work	Knowledge is tested by a written and oral exam. During classes, colloquia are organized (around three colloquia), and assignments are given approximately every two weeks. Students who do not pass the written part through colloquiums and assignments have 4 additional exam deadlines for passing the written part. The oral exam is taken after the written part.

Required literature

Title	Number of copies available	Availability on other medium
Statistical mechanics-3rd ed. R. K. Pathria, Paul D. Beale, 2011 Elsevier Ltd		
Elementary Statistical Physics, C. Kittel, Dover Publications, 2004		
Script Statistical physics, D. Sunko		

Supplementary literature	Elementary Statistical Physics, C. Kittel, Dover Publications, 2004 Introduction to Statistical Physics, Kerson Huang, Taylor and Francis, 2001. K. Dill and S. Bromberg, Molecular Driving Forces: Statistical Thermodynamics in Biology, Chemistry, Physics, and Nanoscience, Garland Science; 2nd edition (2010) Feynman, The Feynman Lectures on Physics, (Chapters 39-46), 1963. Scientific articles, lectures

Quality assurance	The success of the program is monitored by the quality of knowledge demonstrated in the exams as well as by the assessment of the demonstrated enthusiasm for the subject. External evaluation includes student surveys. Statistics of exam results and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Normed spaces</td></tr>
<tr><td>ID</td><td>PMM605</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Saša Krešić Jurić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The course objective is to introduce students with advanced knowledge of normed spaces with special emphasis on Hilbert and Banach space theory. This gives the basics for more advanced studies in modern functional analysis, in particular in operator algebra theory.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Courses taken: Metric spaces, Vector spaces</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">It is expected that a student will
– understand special properties of basic topological concepts (convergence, continuity, compactness) and metric concepts (boundedness, total boundedness, completness, uniform continuity) in normed spaces
– be able to state and prove basic results about Hilbert and Banach spaces and bounded operators between such spaces
– be able to apply the theory in the course to solve a variety of problems at an appropriate level of difficulty
– be able to decide whether a simple statement about normed spaces and bounded operators is true, providing a proof or counterexample as appropriate
– develop critical and analytical thinking and demonstrate skills in communicating mathematics orally and in writing</td></tr>
<tr><td>Syllabus</td><td colspan="6">– Basic notions (12 hours)
Algebraic basis and dimension of a vector space. Norm and inner product. Equivalence of norms. Bounded linear operators. Normed space of bounded linear operators. Dual space of a normed space. Complete normed space. Completion of a normed space. Riesz lemma. Finite-dimensional normed space. Schauder basis of a normed space.
– Spaces lp and Lp (8 hours)
Spaces lp and their dual spaces. Spaces Cp([a,b]) and their completions Lp([a,b])
– Separable inner product and Banach spaces (7 hours)
Orthonormal basis. Structure theorems for infinite dimensional separable inner product and Banach spaces.
– Hahn-Banach extension theorem and consequences (6 hours)
– Hilber spaces (6 hours)
Riesz projection theorem. Riesz representation theorem. Characterization of Hilbert spaces.
– Classical theorems of functional analysis (6 hours)
Uniform boundedness principle. Banach-Steinhaus theorem. The open mapping theorem. Banach inverse mapping theorem. The closed graph theorem.</td></tr>
</table>

Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	Attendance at lectures, seminars and exercises, written assignments, self-study using required and optional literature		

Monitoring student work	Class attendance	1.5	Research		Practical work	
	Experimental work		Paper		Ispit	4.5
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	The exam consists of written and oral part. The oral part comes after positively graded (at least 50%) written part Both parts of the exam are equally evaluated in the final grade.

Required literature	Title	Number of copies available	Availability on other medium
	E. Kreyszig, Introductory functional analysis, John Wiley and sons, New York, 1978.		da
	S. Kurepa, Funkcionalna analiza, Liber, Zagreb, 1992		
	J.J. Koliha, Metrics, Norms, Integrals, World Scientific, London, 2008.		

Supplementary literature	G. Bachman, L. Narici, Functional analysis, Dover Publications, New York, 2000. W. Rudin, Functional analysis, McGraw-Hill, New York, 1973.
Quality assurance	Exam statistics and students' quality evaluation through anonymous poles.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Nuclear Physics</td></tr>
<tr><td>ID</td><td>PMP203</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivana Weber</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Understanding the basic properties of atomic nuclei. Understanding the fundamental models used to describe nuclear states and processes. Applying laws that describe processes in atomic nuclei.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Learning outcomes anticipated from the courses of general physics (Mechanics, Electricity and Magnetism, Waves and Optics, and Thermodynamics) and attended the course of Quantum Physics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Explain the basic properties of atomic nuclei.
2. Critically discuss and apply the fundamental models used to describe atomic nuclei.
3. Explain the spontaneous radioactive decays of atomic nuclei and apply relevant laws.
4. Explain nuclear reactions and apply them in given examples.
5. Critically discuss the application of nuclear processes and their impact on life.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Introduction. The structure of the nuclei, basic nuclear properties.
2. The mass and size of the nuclei. Nuclear properties in the ground state.
3.Nuclear forces. Total angular momentum, spin and magnetic momentum.
4. Nuclear models: Mean potential model.
5. Nuclear models: Fermi gas model.
6. Nuclear models: Liquid-drop model.
7. Nuclear models: Shell model.
8. Nuclear models: Collective model.
9. Radioactivity.
10. Nuclear decays: Alpha decay. Quantum-mechanical model of alpha-decay.
11. Nuclear decays: Beta decay, gamma decay.
12. Nuclear reactions.
13. Nuclear fission. Nuclear fusion.
14. Nuclear processes in stars.
15. Radiation and life.</td></tr>
</table>

<table>
<tr><td>Teaching types</td><td colspan="3">☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="7">Attendance at classes and passing exams: problems and theory (either through partial exams or the entire curriculum in exam terms) – success in each part at least 50%.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td colspan="2"></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="7">The work of students is evaluated during classes, through two partial exams and/or a final exam. Problem-solving on the written exam and the theoretical part in the oral exam are evaluated separately.</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="5">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="5">J.Rich, M. Spiro, Fundamentals in Nuclear Physics, Springer 2005</td><td>3</td><td></td></tr>
<tr><td colspan="5">Prezentacije predavanja i vježbi, I. Weber</td><td></td><td>Online – dostupno svima</td></tr>
<tr><td>Supplementary literature</td><td colspan="7">1. S.M. Wong, Introductory Nuclear Physics, Second Edition, Wiley & Sons, New York, 1998
2. A. Beiser, Concepts of Modern Physics, Mc Graw-Hill, 2003.
3. W. N. Cottinghm, D.A. Greenwood, An Introduction to Nuclear Physics, Cambridge University Press, 2001</td></tr>
<tr><td>Quality assurance</td><td colspan="7">Regular validation of learning outcome during classes.

Statistical analysis of exam results, and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="7"></td></tr>
</table>

Subject name	Numerical analysis		
ID	PMM118	Study year	1.
Lecturer	izv. prof. dr. sc. Jurica Perić	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 30, P: 0
Subject status	Elective	Online percentage	40%
Subject description			
Subject goals	Students will acquire knowledge and skills in numerical analysis, especially in the field of analysis of errors in computer arithmetic, numerical solution of ordinary differential equations and partial differential equations. This will enable them to solve problems that arise in practice, especially in the natural sciences (such as, physics), technical sciences, … Also they will become familiar with some of the existing software packages which can be used in solving such problems.		
Enrolment requirements	Successfully completed course „Introduction to numerical mathematics“.		
Learning outcomes	The student is able to: – estimate and classify errors when executing algorithms in computer – explain and analyze advanteges and disadvanteges of representation of real and integer numbers into computer, IEEE arithmetic – choose one of the studied methods and solve the initial (or boundary) problem for ordinary differential equation – compare and relate concepts method order, consistency, convergence, stability – explain studied methods for numerical solving of partial differential equations		
Syllabus	Representation of the number in computer, computer arithmetic – 4 hours Analysis of errors – 4 hours Ordinary differential equations: initial problem (one-step and multi-step methods, especially Runge-Kutta methods), boundary problem, variational approach – 14 hours Introduction to numerical solution of partial differential equations: elliptic, parabolic and hyperbolic differential equations – 8 hours		
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	Attendance at 70% of lectures and 70% of exercises.		

Monitoring student work	Class attendance	1	Research		Practical work	

	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	1.5	Oral exam	1.5		
	Written exam	1	Project			

Assessment and evaluation of student work	The exam is taken in written and oral form. Written exam is preliminary part of the exam and requirement for the oral exam is to pass a written exam. The written form of the exam can be taken partially, during class, where curriculum provided. Activity in class, solving homework, colloquium, written and oral examination are the elements from which form the final grade is formed.		
Required literature	Title	Number of copies available	Availability on other medium
	V. Hari at all, Numerička analiza, PMF-MO, Zagreb, 2003.		
	J. Stoer, R. Bulirsch, Introduction to Numerical Analysis, Springer, New York, 1993.		
	Nicholas J. Higham, Accuracy and Stability of Numerical Algorithms, SIAM, 2002.		
Supplementary literature	D. Kincaid, W. Cheney, Numerical Analysis – Mathematics of Scientific Computing, Brooks/Cole Publishing Company, 2002. D. N. Arnold, A Concise Introduction to Numerical Analysis, University of Minnesota, Minneapolis, 2001		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Numerical linear algebra</td></tr>
<tr><td>ID</td><td>PMM210</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Ivan Slapničar</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">40%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Introducing methods of numerical linear algebra that are commonly used in scientific and technical applications, the ability to assess the accuracy of the method, the ability to make own algorithms and the use of existing programming libraries.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Successfully completed courses „Linearna algebra“, „Foundation of mathematical analysis“.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">The student is able to:

operate with basic theorems in the theory of optimal approximation (approximation from a given set, the existence, uniqueness)
reproduce basic matrix norms and their properties
analyze differences in solving system of linear equations, solve system of linear equations using Gaussian algorithm (LU factorization, LU factorization with pivoting) and Cholesky algorithm
examine the numerical properties if operations in the algorithm are performed on the computer in the final precision arithmetic
explain and use SVD decomposition
Analyze orthogonal diagonalization of a matrix
explain Householders factorization and its advantages</td></tr>
<tr><td>Syllabus</td><td colspan="6">The fundamental ideas of linear algebra: basic algorithms on matrices, vector and matrix norms. - 2 hours
Computer arithmetic. - 2 hours
Systems of linear equations: Gauss algorithm, Cholesky algorithm, accuracy and improvement of accuracy. - 4 hours
Iterative methods. - 2 hours
Least squares problem (LS) and QR decomposition. - 4 hours
Eigenvalue problem for symmetric matrices: QR method, Jacobi method. - 4 hours
Gram-Schmidt orthogonalization, Householder factorization. - 4 hours
Singular Value Decomposition (SVD), fast updating of SVD decomposition (updating and downdating). - 4 hours
Latent Semantic Indexing (LSI) and the application of SVD decomposition for constructing Web browser. - 4 hours</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars</td><td colspan="2">☐ Fieldwork
☐ Individual assignments</td><td colspan="3">☐</td></tr>
</table>

	☑ Exercises ☐ Fully online ☐ Combined online		☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐	
Student obligations	Attendance at 70% of lectures and 70% of exercises.					
Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	1.5	Oral exam	1.5		
	Written exam	1	Project			
Assessment and evaluation of student work	The exam is taken in written and oral form. Written exam is preliminary part of the exam and requirement for the oral exam is to pass a written exam. The written form of the exam can be taken partially, during class, where curriculum provided. Activity in class, solving homework, colloquium, written and oral examination are the elements from which form the final grade is formed.					

Required literature	Title	Number of copies available	Availability on other medium
	G. H. Golub i C. F. Van Loan: Matrix Computations, 3rd Edition, John Hopkins University Press, Baltimore, Maryland, 1996.		
	E. Anderson i drugi: LAPACK Users' Guide, 2nd Edition, SIAM, Philadelphia 1995.		
	M. W. Berry, Z. Drmač, E. R. Jessup: Matrices, Vector Spaces and Information Retrieval, SIAM Review, 41 (1999) 335–362.		
	J. W. Demmel, Applied numerical linear algebra, SIAM, 1997.		

Supplementary literature	G. W. Stewart, Afternotes on Numerical Analysis, SIAM, Philadelphia, 1996. G. W. Stewart, Afternotes on Numerical Analysis: Afternotes Goes to Graduate School, SIAM, Philadelphia, 1998
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Ordinary differential equations</td></tr>
<tr><td>ID</td><td>PMM103</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Andrijana Ćurković</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">40%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Introduce students to basic ideas of ordinary differential equations. Assure understanding of basic models. Demonstrate theorems of existence and uniqueness of solution as well as some of the commonly used techniques for finding solutions with emphasis on the theory of linear equations.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Differential and Integral Calculus I</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After completing the course, students are expected to:

identify real-life problems which can be modeled by differential equations;
explain in their own words conditions that ensures existence and uniqueness of a solution of the Cauchy problem;
distinguish characteristic properties of linear equations and systems from nonlinear ones;
select and apply appropriate methods to solve basic differential equations;
identify and apply initial and boundary values to find particular solution. .</td></tr>
<tr><td>Syllabus</td><td colspan="6">Introduction: Definitions and Terminology. Differential Equations as Mathematical Models (1 week)

First Order Ordinary Differential Equations: Existence and Uniqueness of Solution. Different types of First Order Equations (including ODE with separable variables, homogeneous, Bernoulli, exact) Applications. (4 weeks)

Higher Order Differential Equations: Reduction of Order. Homogeneous Linear Equations with Constant Coefficient. Nonhomogeneous Equations (Undetermined Coefficients, Variation of Parameters). Laplace Transform Methods (5 weeks)

Linear System of First Order Differential Equations: Preliminary Theory. The eigenvalue method for homogeneous systems. Variation of Parameters (3 weeks)

Orthogonal Functions: Orthogonal Functions. Sturm-Liouville Problem. Examples. (2 weeks)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises</td><td colspan="2">☐ Fieldwork
☐ Individual assignments
☐ Multimedia</td><td colspan="3">☐
☐</td></tr>
</table>

	☐ Fully online ☐ Combined online		☐ Laboratory ☐ Mentoring		☐ ☐	
Student obligations	Attend class regularly and take notes. Take exams when scheduled.					
Monitoring student work	Class attendance	2	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	2		
	Written exam	2	Project			
Assessment and evaluation of student work	The final exam consists of a written and an oral part. Successful written exam is required for taking the oral exam. Acceptable results achieved in midterm exams taken during the semester replace the written part of the exam.					

Required literature	Title	Number of copies available	Availability on other medium
	D.G. Zill and M.R. Cullen, Differential Equations with Boundary-Value Problems, Brooks/Cole, Cengage 2009.		
Supplementary literature	W.E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, John Wiley & Sons, Inc., New York, 2012. M. Alić, Obične diferencijalne jednadžbe, skripta, PMF-Zagreb, Matematički odjel, 1994		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Renewable Energy Sources</td></tr>
<tr><td>ID</td><td>PMT179</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivan Peko</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Enabling students to:
– Acquisition of basic knowledge in the field of renewable energy sources (their importance, potentials and limitations, advantages and disadvantages),
– The permanent adoption and deepening of knowledge in the field of renewable energy,
– Understanding of modern technologies for the exploitation of renewable energy sources,
– Simple calculations of components and systems for exploitation of renewable energy sources.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">There are no requirements for course enrolment.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students will be able to after successfully mastering the subject:
1. define and describe the various renewable energy sources (RES),
2. explain the need for renewable energy sources (RES) and critically assess their strengths and weaknesses,
3. sketch simple RES systems,
4. Apply the acquired knowledge in other courses as well as in future teaching practice.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Week 1:
Lecture (2 hours): Introductory lecture. Introducing students to the rules, literature and teaching assignments. Getting to know with the content of the course. Introduction, definitions, problems with the current energy system, possible solutions. Energy statistics.
Week 2: Lecture (1 hour): Solar energy and technology for its use; solar thermal systems.
Seminar (1 hour): Distribution of seminar papers to students.
Week 3:
Lecture (2 hours): Solar energy and technology for its use; solar power plants and photovoltaic systems.
Week 4:
Lecture (2 hours): Wind energy; wind turbines.
Week 5:
Lecture (2 hours): Hydropower; hydroelectric power plants, water turbines.
Week 6:
Lecture (2 hours): Tidal power, energy of ocean currents, sea waves energy, geothermal energy and technology for its exploitation.
Course content broken down in detail by weekly class schedule (syllabus) Week 1:</td></tr>
</table>

	Lecture (2 hours): Introductory lecture. Introducing students to the rules, literature and teaching assignments. Getting to know with the content of the course. Introduction, definitions, problems with the current energy system, possible solutions. Energy statistics. Week 2: Lecture (1 hour): Solar energy and technology for its use; solar thermal systems. Seminar (1 hour): Distribution of seminar papers to students. Week 3: Lecture (2 hours): Solar energy and technology for its use; solar power plants and photovoltaic systems. Week 4: Lecture (2 hours): Wind energy; wind turbines. Week 5: Lecture (2 hours): Hydropower; hydroelectric power plants, water turbines. Week 6: Lecture (2 hours): Tidal power, energy of ocean currents, sea waves energy, geothermal energy and technology for its exploitation. Week 7: Lecture (2 hours): Biomass energy. Week 8: Lecture (2 hours): Hydrogen Energy Technologies Week 9: Seminar (2 hours): Presentation of seminar papers. Week 10: Seminar (2 hours): Presentation of seminar papers. Week 11: Seminar (2 hours): Presentation of seminar papers. Week 12: Seminar (2 hours): Presentation of seminar papers. Week 13: Seminar (2 hours): Presentation of seminar papers. Week 14: Seminar (2 hours): Presentation of seminar papers. 15th week: Seminar (2 hours): The future of renewable energy sources, conclusions.
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☑ Consultations ☐ ☐ ☐
Student obligations	Active participation in lectures. Independent preparation and presentation of the seminar. Active participation in the

<table>
<tr><td></td><td colspan="6">teaching process.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>1</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">The exam or checking of acquired competences will be done through seminars. Each student or group of students will receive two tasks / themes that they need to be processed in two seminars and present them to the teacher and their colleagues</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">1. Online lectures about renewable Energy sources,</td><td></td><td></td></tr>
<tr><td colspan="4">2. B. Labudović, Obnovljivi izvori energije, Energetika marketing, Zagreb, 2002.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">1. A. Azapagic, R. Clift, Sustainable Development in Practice, John Wiley & Sons, NY, 2004.
2. V. Knapp, Novi izvori energije, Školska knjiga, Zagreb, 1993.
3. V. Paar, Energetska kriza: gdje (ni)je izlaz?, Školska knjiga, Zagreb, 1984
4. Godfey Boyle, Renewable Energy, Oxford Univesity Press, 2004.
5. Internet</td></tr>
<tr><td>Quality assurance</td><td colspan="6">– Taking attendance at lectures;
– The annual analysis of the success of the examination;
– Student survey in order to evaluate teachers;
– Feedback from students who have already graduated from the relevance of the course content,
– Self-evaluation.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

Subject name	Natural language processing		
ID	PMII45	Study year	2.
Lecturer	izv. prof. dr. sc. Branko Žitko	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 30, P: 0
Subject status	Elective	Online percentage	0%

Subject description	
Subject goals	Deep learning models are becoming appropriate to describe complex language utterances. Often, deep learning models can be trained with single end-to-end model and do not require traditional feature engineering or classical approach. The course is a practical introduction to describing, producing, analyzing, and applying real-world deep learning models for natural language processing.
Enrolment requirements	computer programming and algorithms basic probability and statistics calculus and linear algebra
Learning outcomes	identify basic deep learning models applied in natural language processing describe basic deep learning models for natural language processing create software to store and analyze deep learning model for natural language processing analyze and evaluate deep learning model for performance implement deep learning models for natural language processing apply deep learning models to real-world problems
Syllabus	Introduction and course overview Word vector representations Global vectors for word representation Word window classification and neural networks Dependency parsing RNN and language models Machine translation and advanced RNNs Neural machine translation and models with attention End-to-end models for speech processing CNNs in natural language processing Tree recursive neural networks and constituency parsing Coreference resolution Dynamic neural networks for question answering
Teaching types	☑ Lectures ☐ Fieldwork

	☐ Seminars ☑ Exercises ☐ Fully online ☑ Combined online	☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	attend lectures and exercises submit homework and other assignments		

Monitoring student work	Class attendance	1	Research	1	Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	1	Oral exam			
	Written exam	1	Project	1		

Assessment and evaluation of student work	homework (25%) project report (25%) written exam (50%)

Required literature	Title	Number of copies available	Availability on other medium
	D. Jurafsky, J. H. Martin, (2000) Speech and Language Processing, PrenticeHall	1	
	C. D. Manning, H. Schütze, (1999) Foundations of Statistical Natural Language Processing		

Supplementary literature	Relevant research articles
Quality assurance	Quality assurance methods that ensure the acquisition of exit competences anonymous survey direct feedback exam success self-assessment
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Signal Processing in Natural Sciences</td></tr>
<tr><td>ID</td><td>PMP125</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Damir Kovačić</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">To familiarize students with:
– Basic concepts in signal processing that appear in natural sciences
– Key signal processing methods</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Enrolled one of the diploma study programs.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. To describe and classify different types of signals.
2. To define and describe the basic concepts of signal processing theory.
3. To include examples of the application of digital signal processing in natural sciences.
4. To apply knowledge to solve simple signal processing problems.
5. To define and describe the basic concepts of digital processing theory and the analysis of sound and image signals.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Lecture: Introduction – definitions: signal, signal processing, information, system analysis, transformation.
2. Lecture: Continuous and discrete signal representation
3. Lecture: Convolution and deconvolution
4. Lecture: Autocorrelation and signal correlation
5. Lecture: System Realization
6. Lecture: Linear and time-invariant systems
7. Lecture: Fourier Transformation and Signal Spectrum (DFT, FFT)
8. Lecture: Filters
9. Lecture: Transformations and interpolation of signals
10. Exercises: Practical methods of signal analysis
11. Exercises: Spectral signal analysis
12. Exercises: Analog and digital signal processing
13. Exercises: Practical examples of signal processing in natural sciences 1-5 (physics, mathematics, biology, chemistry, technique)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☑ Exercises
☐ Fully online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☑ Laboratory</td><td colspan="4">☐
☐
☐
☐</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">☐ Combined online</td><td colspan="3">☐ Mentoring</td><td></td></tr>
<tr><td>Student obligations</td><td colspan="6">The student is required to attend lectures, seminars and exercises, with a maximum of 20% of excused absences. The student is required to write a term paper with the chosen topic and present it in the form of presentation to colleagues and teacher.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>2</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td>1</td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">The grade is determined based on:
- Colloquium (25% grade)
- Seminar paper (50% grade)
- Oral presentation (25% grade)</td></tr>
<tr><td rowspan="4">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Hrvoje Babić (2001.), Signali i sustavi</td><td></td><td></td></tr>
<tr><td colspan="4">William Hartmann: Signals, Sound, and Sensation</td><td></td><td></td></tr>
<tr><td colspan="4">B. P. Lathi (2004.), Linear Systems and Signals</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Oppenheim, Alan, and Alan Willsky. Signals and Systems</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Evaluation of results in accordance with the determined learning outcomes. Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.
Self-evaluation of teacher.
Institutional and non-institutional checks.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

Subject name	Selected Topics in Biochemistry		
ID	PPC207	Study year	3.
Lecturer	izv. prof. dr. sc. Matilda Šprung	Points value (ECTS)	2.0
Associates		Class execution (number of hours in semester)	L: 15, S: 15, E: 0, P: 0
Subject status	Elective	Online percentage	50%

Subject description

Subject goals	The goal of the course is to enable and encourage students to deepen their knowledge in the field of biochemistry by following the rapid progress of specific areas and topics of particular personal interest.
Enrolment requirements	Biochemistry I
Learning outcomes	Upon completion of the course, students will be able to: 1.recognize areas of biochemistry in rapid development 2.recognize relationships between biochemistry and other scientific disciplines (medicine, ecology, agronomy, etc.) 3.use scientific literature 4.condense the literature studied in the form of a popular science presentation
Syllabus	Course topics depend on recent discoveries in biochemistry and the interest of enrolled students. Each student presents one topic, and the instructor presents three topics of interest to enrolled students.
Teaching types	[x] Lectures [x] Seminars [ ] Exercises [ ] Fully online [x] Combined online [ ] Fieldwork [x] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring
Student obligations	An 80% of class attendance is required. Students must prepare and present a seminar work.

Monitoring student work						
	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper		Exam preparation	0.9
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam			
	Written exam	0.1	Project			

Assessment and evaluation of student work	Passing the written exams is determined by 50% of the total score, and the questions are created in accordance with the learning outcomes established for each presentation. The written part of the exam comprises 50% of the total score, and the seminar comprises another 50%.

Required literature	Title	Number of copies available	Availability on other medium
	Selected scientific articles from the journals such are Nature, TIBS, Annual Reviews in Biochemistry, etc., critically evaluated Internet sources.		
Supplementary literature			
Quality assurance	Personal consultations, completion of partial exams, student survey to evaluate subject and instructor, evidence of class attendance, analysis of passing rate on final exams.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Full Stack Development</td></tr>
<tr><td>ID</td><td>PMIC61</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Goran Zaharija</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Introduction to techniques and tools for creating web applications, with emphasis on all aspects of development – user and server-side. The goal of the subject is to familiarize students with all phases of web application development, as well as deploying the application in a production environment. Current development, management, and monitoring tools would be used for this purpose.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Web Application Programing (Programiranje mrežnih aplikacija)
Databases (Baze podataka)</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Set up a development environment for web applications
2. Manage the development phase of the application lifecycle
3. Understand the basics of development on the user side (frontend)
4. Understand the basics of development on the server-side (backend)
5. Design and implement databases
6. Use production systems and deploy the program solution to a production server.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Web application development, technologies, development environment
2. Application version control (Git)
3. Running the application in a production environment (Heroku, Azure)
4. UI/UX – user interface and user experience
5. Responsive design of the application, layout (Flexbox)
6. CSS preprocessors
7. Designing applications using existing frameworks (Bootstrap, Materialize, PureCSS)
8. React, Vue – JavaScript development frameworks for building web applications
9. Node.js – creating the backend part of the application (server)
10. Midterm exam
11. Types of web requests and routing
12. API services – using and creating your own API server
13. Relational and non-relational databases in web application development
14. User authentication – internal and external solutions
15. Monitoring, management, and upgrading of an active application.</td></tr>
</table>

<table>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td colspan="2">☑
Workshops
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="7"></td></tr>
<tr><td rowspan="5">Monitoring student work</td><td colspan="2">Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td>2</td></tr>
<tr><td colspan="2">Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Colloquiums</td><td></td><td>Oral exam</td><td>0.5</td><td></td><td></td></tr>
<tr><td colspan="2">Written exam</td><td>0.5</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="7">Attendance (10%)
Practical work (30%)
Written / oral exam (60%)</td></tr>
<tr><td rowspan="4">Required literature</td><td colspan="5">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="5">Ben Frain, Responsive Web Design with HTML5 and CSS3, Packt Publishing; second edition (2017)</td><td></td><td></td></tr>
<tr><td colspan="5">Chris Aquino, Todd Gandee; Front-End Web Development: The Big Nerd Ranch Guide; Big Nerd Ranch Guides; first edition (2016)</td><td></td><td></td></tr>
<tr><td colspan="5">Vasan Subramanian; Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node; Apress; first edition (2017)</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="7">Teaching materials available on the Internet, including solutions to selected tasks and additional scientific literature</td></tr>
<tr><td>Quality assurance</td><td colspan="7">Conversation with students, anonymous student survey, student success on the course, self-analysis.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="7"></td></tr>
</table>

Subject name	Observational Astronomy		
ID	PMP410	Study year	1.
Lecturer	doc. dr. sc. Koraljka Mužić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 30, S: 15, E: 15, P: 0
Subject status	Elective	Online percentage	0%

Subject description	
Subject goals	
Enrolment requirements	
Learning outcomes	
Teaching types	☐ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	

Monitoring student work						
	Class attendance		Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation of student work			
Required literature	Title	Number of copies available	Availability on other medium
	–		
Supplementary literature			
Quality assurance			
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="7">General Physics</td></tr>
<tr><td>ID</td><td>PMP090</td><td>Study year</td><td colspan="5">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Željana Bonačić Lošić</td><td>Points value (ECTS)</td><td colspan="5">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td colspan="2">P</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td colspan="2">0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="5">10%</td></tr>
<tr><td colspan="8">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="7">Enable acquiring knowledge and student competences in general physics that are useful for further studies and application in their area of expertise.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="7">None.</td></tr>
<tr><td>Learning outcomes</td><td colspan="7">Student should be able to :
1. correctly state and apply the basic concepts of general physics.
2. correctly state and apply the basic laws of general physics.
3. apply the acquired knowledge to solve simple problems in general physics.
4. apply the acquired knowledge in chemistry and biology.</td></tr>
<tr><td>Syllabus</td><td colspan="7">1. Introduction. Measurements. (2h)
2. Motion in one, two and three dimensions. (2h)
3. Laws of motion. Kinetic energy and work. (2h)
4. Potential energy and conservation of energy. Many particle systems. (2h)
5. Rotational motion. Gravity. Solids and fluids. (2h)
6. Oscillations and waves. sound waves. (2h)
7. Temperature, heat and the first law of thermodynamics. (2h)
8. Entropy and the second law of thermodynamics. (2h)
9. Electric charge. Electric field and potential. (2h)
10. Electric currents and resistance. (2h)
11. Magnetic field. Maxwell equations. (2h)
12. Electromagnetic oscillations and alternating current. Electromagnetic waves. (2h)
13. Optics. Wave optics. Relativity. (2h)
14. Photons. Matter waves Physics of atom. Laser. Solid state. (2h)
15. Nucleus. Radioactivity. Biological systems. (2h)
Solving problems numerically, introduction to measurements, and measurements of selected physical properties.</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises</td><td colspan="2">☐ Fieldwork
☐ Individual assignments
☐ Multimedia</td><td colspan="4">☐
☐
☐</td></tr>
</table>

	☐ Fully online ☐ Combined online		☐ Laboratory ☐ Mentoring		☐	
Student obligations	Lectures with interactive simulations and experiments. Solving problems instructed by assistant. Uninfluenced solving of problems. Active lectures and exercises attendance.					
Monitoring student work	Class attendance	1.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	1.5		
	Written exam	1.0	Project			
Assessment and evaluation of student work	Preliminary exams. Written exam. Oral exams.					
Required literature	Title				Number of copies available	Availability on other medium
	M. Dželalija, Opća fizika s primjerima fizike bioloških sustava (u pripremi), Sveučilište u Splitu, 2005.					
Supplementary literature	R. A. Serway, J. S. Faughn, College Physics, Fifth Edition, Saunders College Publishing, Orlando, 2000. Earth Systems, Processes and Issues, ed. by W.G. Ernst, Cambridge University Press, 1999.					
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">General Relativity and Cosmology</td></tr>
<tr><td>ID</td><td>PMP400</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Zvonimir Vlah</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The first part of the course will cover the basics of general relativity, its mathematical foundations: Special Relativity; Manifolds, Riemannian metric, connection, curvature; Equivalence principle; Energy-momentum tensor, field equations, Newtonian limit; Post-Newtonian approximation; Schwarzschild solution; Black holes, Gravitational waves. The second part will cover the following topics; FLRW metric and homogeneous cosmology; Thermal history of the universe; Dark matter and Dark Energy; Cosmic microwave background; Structure formation.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Students should have good grasp of material typpically covered in courses:
- Classical electrodynamics
- Mathematical Methods in Physics
- Special Theory of Relativity</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">On successful completion of this course, students should:
- have good understanding of the Special Relativity
- be familiar with the geometrical representation of General Relativity and its link to Newtonian gravity
- basic understanding the black hole solutions in General Relativity, and be familiar with the gravitational waves and its origins within the scope of General Relativity
- grasp the basic picture of the homogeneous cosmology and evolution of the Universe</td></tr>
<tr><td>Syllabus</td><td colspan="6">Short Review of Special Theory of Relativity
Introduction and the Geometric Viewpoint on Physics
Gravity and Einstein's Equations
Schwarzschild Solution and Black Holes
Perturbation theory and Newtonian limit
Gravitational waves Cosmology and FLRW metric
History and evolution of the universe
CMB and the structure formation in the universe</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☑ Fully online</td><td>☐ Fieldwork
☐ Individual assignments
☑ Multimedia
☐ Laboratory</td><td colspan="4">☑ homework assignments
☐</td></tr>
</table>

	☑ Combined online		☐ Mentoring			☐ ☐
Student obligations	Students should: – participate and follow the lectures and exercises (at least 70%) – work through the assigned material and lecture notes – work on homework assignments – actively participate in the interactive part of the lectures					
Monitoring student work	Class attendance		Research		Practical work	
	Experimental work		Paper		Homework assignments	3
	Essay		Seminar paper			
	Colloquiums		Oral exam	3		
	Written exam		Project			
Assessment and evaluation of student work	The examination consists of two parts: – homework assignments: 50% – final oral examination: 50%					
Required literature	Title				Number of copies available	Availability on other medium
	S. Carroll – Spacetime and Geometry: An Introduction to General Relativity					
Supplementary literature	R. Wald – General Relativity S. Weinberg – Gravitation and Cosmology A. Zee – Einstein Gravity in a Nutshell B. Schutz – A first course in General Relativity,					
Quality assurance	Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.					
Other (in the opinion of the proponent)						

Subject name	General Zoology						
ID	PMB013	Study year	1.				
Lecturer	prof. dr. sc. Biljana Apostolska	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	0	45	0	
Subject status	Compulsory	Online percentage	10%				
Subject description							
Subject goals	– to understand and use knowledge and terms from morphology, systematics, filogeny and evolution of animals – to be able to explain and comparate different organs and their development between different groups of animals – to recognize all kind of animal tissue and organs by microsope – embriology and postembriology of animals – those lectures and knowledge is necessary for understanding other zoology lectures on the higher level of study						
Enrolment requirements	None						
Learning outcomes	Student will be able to: 1. define systematics and taxonomy of Regnum animalium 2. binar nomenclature and latin names 3. description of organs and their physiology 4. to define and use basic zoological terms 5. independent use of microscope and stereozoom microscope – 6. independent use of laboratory instruments						
Syllabus	Lectures: 1. Zoology – introduction 2. Evolution, Darwin and Wallace, theory of evolution, mechanisms, mikroevolution, makroevolution, variability, definition of population and species, isolation mechanisms, speciaation, systemacs, taxonomy, the principles of classification of animals, filogeny, zoological nomenclature, Linne, cladistics, the basic methodology in zoological research, 3. Prokariotes and Eukariotes, evolution of metazoans, Theories of Metazoa, 4. Protozoa, Metazoa, Ameria, Polymeria, Oligomeria, Tunicata, Cephalochordata, Cyclostomata, Chondrichthyes, Osteichtyes, Amphibia, Reptilia, Aves, Mammalia, 5. The structure and function of organs and organ systems 6. Integument organs 7. Skeletous organs 8. Muscular system 9. Neurological system of organs with receptors 10. Respiratory system 11. Circulatory system of organs						

	12. Digestive organs 13. Excretory sytem 14. Reproduction in animals 15. Hormones Exercises: 1. Microscope 2. Promorfology I 3. Promorfology II 4. Integument organs 5. Skeleton 6. Muscles 7. Neuron system of organs 8. Receptors 9. Digestive organs 10. Respiratory system 11. Circulatory system 12. Exscretory organs 13. Reproduction 14. Embriology 15. Postembriology
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☑ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	To participate on lectures and exercises in full

Monitoring student work:

Class attendance	1	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper	1		
Colloquiums	2	Oral exam	1		
Written exam	1	Project			

Assessment and evaluation of student work	Two partial exams; first one after the lectures Digestive system, second one at the end of subject. Students who didn't pass the partial exams are obligate to pass written exam inside the regular dat The lectures from laboratory skills are included in written exam.

Required literature

Title	Number of copies available	Availability on other medium
Matoničkin, I., Erben, R. (2002): Opća zoologija. Školska knjiga, Zagreb.		

	I., Erben, R., Habdija, I. (1983): Praktikum iz opće zoologije. Sveučilište u Zagrebu, Zagreb		
Supplementary literature	Miller, S.A., Harley, J.P. (2004): Zoology. McGraw-Hill, Boston. Hickman, C. Jr., Roberts, L., Larson, A., I'Anson, H. (2003): Integrated Principles of Zoology.McGraw-Hill, Boston. Wheater's Functional Histology: a text and colour atlas, ed. B. Young, J.W. Heath, Churchill Livingstone, London, 2001		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Operating Systems</td></tr>
<tr><td>ID</td><td>PMID70</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Goran Zaharija</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Develop an understanding of the role of the operating system in the computer system that can be accomplished management resources to the best use of computing resources and create an environment for preparing and implementing the program.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Admission requirements: none.
Entry competences: basic knowledge of computer.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students will be able to:
1. Explain the mechanisms of transmission of data between external units and systems
2. Understand and apply the synchronization mechanisms
3. Explain procedures management The storage space
4. Explanation of the functions and use the file system
5. Advanced use operating system UNIX
6. Develop and test multi-threaded programs</td></tr>
<tr><td>Syllabus</td><td colspan="6">Introduction to the subject. The role of the operating system in the computer system. The hierarchical structure, historical development and the parts of the operating system.
Exercises: Introduction to the exercise. Introduction to UNIX. Check-in and check-out operation.
Model simple PC on which to base the study of the operating system. The role of the processor, tanks and outdoor units in the computer. The task, process and instructional threads. Changing context.
Exercises: user directory. Working with directories and files.
Input-output operations. Interrupt data transfer. Data transfer by direct memory access. Hardware for managing multiple breaks with priorities.
Exercise: Balance system. Users. Viewing process. Setting process.
The realization of tasks based on the multithreaded execution. The relationship between threads. Mutual exclusion two threads. Procedures Dekker and Peterson.
Exercise: Redirecting standard input, standard output and output for errors. Chaining commands.
Mutual exclusion larger number of threads. Lamport's protocol. Mutual exclusion is based in the control support.
Exercise: Manage permissions. Links to the files.
The structure of the data center. The descriptor for this thread and this thread transition state. Nuclear features of the monitor, binary and general traffic light.</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">Exercises: Colloquium first
Input-output operations and delay. Instant messaging between processes across an unlimited and limited tank and message queue.
Exercises: The screen editor Vi. Swap files.
Synchronize threads. Necessary conditions deadlock. Strategy in relation to a complete standstill.
Problem five philosophers. Hoareov concept monitor.
Exercises: Shell Programming: Writing and executing shell file. Basic commands.
Time series analysis of computer systems. Basic models of stochastic models of tasks.
Exercises: Shell Programming: Branching instructions.
System analysis of the Poisson distribution of arrivals tasks and exponential distribution of their treatment. Types serving tasks.
Exercises: Shell Programming: repetition statements.
Preparation program for execution. The physical and logical address space. Assigning storage tank farm. Disc features like auxiliary tank. The problem of fragmentation.
Exercise: Regular expressions.
Virtual memory paging mechanism based on. Hardware support for paging.
Exercises: Colloquium second
Paging on demand. Strategy replacement page.
Exercises: Multithreaded Programming: Console applications.
File system. The descriptor file. The descriptor storage tank farm. The functions of the file system.
Exercises: Multithreaded Programming Windows applications.
Study of typical operating systems: Linux and Windows.
Exercises: Colloquium third</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☑ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Lecture 70%, exercise attendance 70%, 3 colloquia, practical and oral examination. Students who are successful in the preliminary exams are released practical exam</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td>2</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>1.5</td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation</td><td colspan="6">Activity of students in exercises (presence, addressing the challenges of homework) (10%).</td></tr>
</table>

<table>
<tr><td>of student work</td><td colspan="3">Practical exam (60%). During the semester are held three preliminary exams (25% + 25% + 10%). The student is successful in a colloquium if achieved half of the expected number of points, but in this case, released a practical exam.
Oral exam (30%) is compulsory for all students, while answering three questions randomly selected from a list of 50 questions divided into three categories.
The final grade is derived on the basis of all these ratings with weighting factors as indicated in parentheses for each form of assessment.</td></tr>
<tr><td rowspan="3">Required literature</td><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td>1. Budin, L., Golub, M., Jakobović, D., Jelenković, L.: Operacijski sustavi, Element, Zagreb, 2010. (16 primjeraka u knjižnici).</td><td>16</td><td></td></tr>
<tr><td>2. M. Žagar: UNIX i kako ga koristiti, Sveučilište u Zagrebu, Fakultet elektrotehnike i računarstva, 2007 (1. internetsko izdanje)</td><td></td><td>da</td></tr>
<tr><td>Supplementary literature</td><td colspan="3"></td></tr>
<tr><td>Quality assurance</td><td colspan="3">Talk with students, student evaluation using the anonymous survey, the success of students in the exam, self-assessment.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="3">Optimization</td></tr>
<tr><td>ID</td><td>PMM922</td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Milica Klaričić Bakula</td><td>Points value (ECTS)</td><td>5.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 30, S: 15, E: 0, P: 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>30%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Optimization is the art of optimal decision making under constraints. Convex optimization refers to a set of problems that can be formulated using convex functions and sets; countless problems from science, engineering and statistics can be cast as convex optimization problems and solved using efficient algorithms.
The main goal of this course is to develop the skills and background needed to recognize, formulate and solve convex optimization problems. The course is intended as an introduction to convex optimization, focusing on the theory, the modelling techniques, and the algorithm analysis and design.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Entry competences: Linear algebra. Numerical linear algebra (basics).</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Upon successful completion of this course students will be able to:

– recognize and formulate convex optimization problems as they arise in practice
– know a range of algorithms for solving linear, quadratic and geometric programming problems, and evaluate their performance
– understand the theoretical foundations and be able to use it to characterize optimal solutions to optimization problems
– appreciate the role of convex optimization in approximation and fitting, statistic and geometry.</td></tr>
<tr><td>Syllabus</td><td colspan="3">– Overview and examples of optimization problems (2)
– Convex sets (2)
– Convex functions (2)
– Convex optimization problems (4)
– Duality (4)
– Unconstrained minimization (6)
– Equality constrained minimization (2)
– Interior-point methods (4)
– Applications (4)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia</td><td>☐
☐</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">☐ Fully online
☐ Combined online</td><td colspan="3">☑ Laboratory
☐ Mentoring</td><td>☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Attending classes, doing homework assignments. Writing and presenting seminars.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td>0.5</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>0.5</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td>2</td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Seminars will be evaluated throughout the semester. Final oral exam.

<table>
<tr><td colspan="3">Continuous assessment</td></tr>
<tr><td>Evaluation elements</td><td>Performance (min)</td><td>Weight in grade (%)</td></tr>
<tr><td>partial written exams</td><td>50</td><td>80</td></tr>
<tr><td>solving problems with Matlab</td><td>100</td><td>20</td></tr>
</table>

<table>
<tr><td colspan="3">Final assessment</td></tr>
<tr><td>Evaluation elements</td><td>Performance (min)</td><td>Weight in grade (%)</td></tr>
<tr><td>final exam</td><td>50</td><td>80</td></tr>
</table></td></tr>
<tr><td rowspan="2">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, 2004</td><td></td><td>e-learning</td></tr>
<tr><td>Supplementary literature</td><td colspan="6">1. J. Nocedal and S.J.Wright, Numerical Optimization, Springer, 2006.
2. A. Ben-Tal and A. Nemirovski. Lectures on Modern Convex Optimization. 2013.</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Summary feedback for the whole class after the exam.
Anonymous student survey.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="3">Fundamentals of Astronomy and Astrophysics</td></tr>
<tr><td>ID</td><td>PMP130</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Marko Kovač</td><td>Points value (ECTS)</td><td>3.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L | S | E | P</td></tr>
<tr><td>30 | 15 | 0 | 0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>30%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Introduce students to the basic concepts of astronomy and astrophysics.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Mechanics (attended)</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">1. Define the units and describe and analyze the methods of measuring distance in astronomy.
2. Define the coordinate systems for orientation in the celestial sphere, describe phenomena related to the rotation and revolution of the Earth (apparent motion of planets, eclipses, changing of seasons, sidereal and synodic period, precession of the Earth).
3. Analyze the principle of operation and structure of observational instruments and detectors, explain the basic observational techniques in astronomy across the entire electromagnetic spectrum.
4. Describe the physical and dynamic characteristics of objects in the Solar System (planets, their satellites, comets, and asteroids) and the formation of planets and planetary systems.
5. Describe the classification of stellar spectra, the physical characteristics of stars and the Sun, and analyze the Hertzsprung–Russell diagram.
6. Identify the basic relationships in the structure of stars and describe the mechanism of pulsation in variable stars.
7. Analyze the internal structure, sources, and transfer of energy in stars, and apply them to the evolution of stars, stellar populations, and stellar clusters.
8. Describe the space radiation and possibilities for its detection, define apparent and absolute brightness, luminosity, radiation intensity.
9. Morphologically classify galaxies and describe the properties and structure of elliptical and spiral galaxies, the Milky Way, and galaxy clusters.
10. Describe the theory of the Big Bang, cosmic microwave background radiation, and analyze observations of the expanding universe.</td></tr>
<tr><td>Syllabus</td><td colspan="3">1. (2+1) Astrognosis
2. (2+1) Historical development of astronomy and astrophysics, 1/2
3. (2+1) Historical development of astronomy and astrophysics, 2/2
4. (2+1) Motion of Earth and phenomena on the celestial sphere
5. (2+1) Celestial mechanics
6. (2+1) Astronomical instruments
7. (2+1) Photometry</td></tr>
</table>

<table>
<tr><td></td><td>8. (2+1) Earth and Moon
9. (2+1) Physics of stars, 1/3
10. (2+1) Physics of stars, 2/3
11. (2+1) Physics of stars, 3/3
12. (2+1) Interstellar matter
13. (2+1) Galaxies
14. (2+1) Special and general theory of relativity
15. (2+1) Cosmic evolution and cosmology</td></tr>
<tr><td>Teaching types</td><td><table><tr><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☑ Individual assignments
☑ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr></table></td></tr>
<tr><td>Student obligations</td><td></td></tr>
<tr><td>Monitoring student work</td><td><table>
<tr><td>Class attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>0.5</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>1</td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Assessment and evaluation of student work</td><td>Twice during the semester, students take a written exam covering two halves of the material. Students who score more than 50% on each exam are exempt from taking the written exam and can proceed to the oral exam. Students who score 50% or more on the first written quiz can take the oral exam in two parts, immediately after the written exam is graded. The final grade is based on the written exam (worth 1/2 of the grade) and the performance on the oral exam (worth 1/2 of the grade).</td></tr>
<tr><td>Required literature</td><td><table>
<tr><th>Title</th><th>Number of copies available</th><th>Availability on other medium</th></tr>
<tr><td>V. Vujnović, Astronomija I, Školska knjiga Zagreb, 1993.</td><td>3</td><td>no</td></tr>
<tr><td>V. Vujnović, Astronomija II, Školska knjiga Zagreb, 1994.</td><td>2</td><td>no</td></tr>
</table></td></tr>
<tr><td>Supplementary literature</td><td>Slides and lecture notes.</td></tr>
<tr><td>Quality assurance</td><td>1. Teachers who have correlated learning outcomes collaborate and jointly ensure the quality of teaching.
2. Statistical analysis of exam results and evaluation of success in accordance with the stated learning outcomes.
3. Student evaluation through an anonymous survey conducted in accordance with the regulations of the University of</td></tr>
</table>

	Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Foundations of geometry</td></tr>
<tr><td>ID</td><td>PMM812</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Goran Erceg</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The course objective is to introduce students with the axiomatic theory of Euclidean and Non-Euclidean geometry</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">It is expected that a student wil be able

- to discuss historical development of new geometries and explain the key role of Euclid's Fifth postulate
- to show understanding of the difference between Euclidean and Non-Euclidean geometry and use both geometries efficiently
- to write and communicate proofs of geometric statements using direct geometric arguments or the method of proof by contradiction
- to understand the development of axiomatic structures and demonstrate increased level of critical and analytical thinking about geometric results</td></tr>
<tr><td>Syllabus</td><td colspan="6">- Historical survey (6 hours)
Euclid and his Elements. First book of Elements. Euclid's Fifth Postulate. Discovery of hyperbollic geometry. Principles of Hilbert's system of axioms.

- Absolute geometry (21 hours)
Axioms of incidence and their consequences (3 hours). Axioms of betweenness and their consequences (6 hours). Axioms of congruence and their consequences (6 hours). Axiom of continuity and its consequences (6 hours).

- Hyperbolic geometry (18 hours)
Axiom of parallels, parallel and ultraparallel lines (3 hours). Asymptotic triangles (3 hours). Lobachevsky function (3 hours). Quadrilaterals with two right angles (3 hours). Common perpendiculars (3 hours). Ponicare model of hyperbolic geometry (3 hours).</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online</td><td colspan="2">☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory</td><td colspan="3">☐
☐
☐
☐</td></tr>
</table>

	☐ Combined online		☐ Mentoring			
Student obligations	Attendance at lectures and exercises, written assignments, self-study using required and optional literature.					
Monitoring student work	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper		Exam	5.5
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	The exam consists of written and oral part. The oral part comes after positively graded (at least 50%) written part Both parts of the exam are equally evaluated in the final grade.					

Required literature	Title	Number of copies available	Availability on other medium
	B. Červar, G. Erceg, I. Lekić, Osnove geometrije, PMF Split		
	G. A. Venema, The foundations of Geometry, Pearson Prentice Hall, New Jersey, 2006		
	M. J. Greenberg, Euclidean and non- Euclidean geometries, W.H. Freeman and Company, New York, 1999		
	A. Fetisov, O euklidskoj i neeuklidskim geometrijama, Školska knjiga, Zagreb, 1981.		

Supplementary literature	Euklid, Elementi I-VI, Kruzak, Zagreb, 1999. B. Artmann, Euclid - The Creation of Mathematics, Springer-Verlag, New York, 1999.
Quality assurance	Exam statistics and students' quality evaluation through anonymous poles.
Other (in the opinion of the proponent)	

Subject name	Basic histological techniques		
ID	PPB259	Study year	3.
Lecturer	doc. dr. sc. Nives Kević	Points value (ECTS)	2.0
Associates		Class execution (number of hours in semester)	L: 15, S: 0, E: 15, P: 0
Subject status	Elective	Online percentage	10%

Subject description

Subject goals	The aim of this course is to introduce basic histological techniques and their application, and to enable students to applying histological techniques at the primary processing of certain histologic material.
Enrolment requirements	None
Learning outcomes	Student will be able to: 1. Describe the basic histological techniques 2. Understand the importance of histological preparations in biology 3. Explain the application of histological methods 4. Independently make a tissue sections using histological techniques
Syllabus	Lectures: / Exercises: Lectures (15 hours): Introduction. Histological techniques. Fixation of tissues. Dehydration and clearing of the tissue. Impregnation of the tissue. Embedding of tissue. Cutting tissue using microtome. Applying histochemical techniques on paraffin sections. Dehydration and fixation of the histological sections. Laboratory exercises (15 hours): Tissue preparation using histological techniques.
Teaching types	☑ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring
Student obligations	Attending of lectures and exercises.

Monitoring student work						
	Class attendance	1.0	Research		Practical work	1.0
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation	

of student work	Students will be evaluated upon tissue preparation.		
Required literature	Title	Number of copies available	Availability on other medium
	Švob, M; Hraste, A. (1979) Praktikum histoloških vježbi. Medicinski fakultet, Tuzla		
	Power Point prezentacije i nastavni materijal		
Supplementary literature	D.C. Sheehan, B.B. Hrapchak (1987) Theory and practice of histotechnology. Battelle Press, Ohio		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)	Aktivno sudjelovanje na nastavi, evaluacija predmeta i nastavnika putem studentskih anketa, konzultacije		

Subject name	Basic algebraic structures						
ID	PMM715	Study year	2.				
Lecturer	doc. dr. sc. Gordan Radobolja	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	0	30	0	
Subject status	Elective	Online percentage	0%				
Subject description							
Subject goals	Adopt basics of commutative rings theory, arithemtic of polynomials and solvability of algebraic equations.						
Enrolment requirements	Prerequisites: completed courses Introduction to Algebra with Analytic Geometry or Linear algebra and Matrix Calculus Required competencies: knowledge of fundamentals of linear algebra and elementary mathematics.						
Learning outcomes	It is expected that the student will be able to: - Geometrically interpet complex numbers, roots of unity and operations with them - Distinguish between a formal polynomial and a polynomial function, between root and a zero-point - State basic definitions and theorems in theory of commutative rings - State, prove and apply the fundamental theorem of arithmetics for polynomials (check reducibility of and factorise a rational polynomial) - Apply Euclidean algorithm - Solve cubics and quartics - Explain the concepts of splitting fields, Galois group and solvability in radicals - Distinguish algebraic and transcendental numbers, and algebraically closed and open fields						
Syllabus	Classical algebra (4 hours) Elementary number theory. Pythagorean triples, fundamental theorem of arithmetic. Number systems. Complex numbers. Roots of unity. Commutative rings (6 hours) Basics Domains and rings of fractions Polynomial ring and polynomial functions Homomorphisms Arithmetic of polynomials (8 hours) Divisibility Roots						

	Factorisation Irreducibility and criteria. Cyclotomic polynomials Field theory (8 hours) Quotient ring Field extensions Algebraic extensions Splitting fields Solvability in radicals (4 hours) Groups Radical extensions Galois theory Insolvability of the quintic
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Class attendance and partial written exams.

Monitoring student work						
Class attendance	2	Research		Practical work		
Experimental work		Paper				
Essay		Seminar paper				
Colloquiums	2	Oral exam	2			
Written exam		Project				

Assessment and evaluation of student work	Partial written exams and final written and oral exam. Positive grade of the written exam is required to take the oral exam.

Required literature

Title	Number of copies available	Availability on other medium
A. Cuoco, J. J. Rotman, Learning modern algebra		

Supplementary literature	D.S. Dummit, R.M. Foote, Abstract Algebra, treće izdanje, John Wiley and Sons, 2004.
Quality assurance	Anonymous student evaluations at the end of semester according to the regulations of the University of Split.

Other (in the opinion of the proponent)	

Subject name	Partial Differential Equations		
ID	PMM915	Study year	1.
Lecturer	prof. dr. sc. Saša Krešić Jurić doc. dr. sc. Tea Martinić Bilać	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 30, P: 0
Subject status	Elective	Online percentage	0%

Subject description	
Subject goals	The course objective is to introduce students to the theory of partial differential equations (PDE) and to teach them basic techniques for finding their solutions. The emphasis is on understanding the theoretical results as well as developing practical skills for problem solving.
Enrolment requirements	Prerequisites: completed courses Differential and Integral Calculus 1 and 2 (or Mathematics 1 and 2), Linear Algebra (or Linear Algebra and Matrix Calculus) and Ordinary Differential Equations (or Differential Equations) Required competences: knowledge of differential and integral calculus in one and two varibles, matrix calculus and ordinary differential equations
Learning outcomes	It is expected that the student will be able to: find Fourier series of a given function, classify second order linear PDEs in two variables, formulate stability problems of PDEs for different types of inital and boundary conditions, find solutions of the heat equation and wave equation by the method of separation of variables, find D'Alambert's solution of the wave equation, find solutions of the Laplace and Poisson equations by the method of separation of varibles for rectangular and circular domains. It is also expected that the student is able to prove the theorems used in the development of the theory of PDEs.
Syllabus	Introduction and elementary techniques (2 hours) Initial and boundary conditions, stability of solutions (2 hours) Fourier series (2 hours) Dirichlet's theorem, uniform convergence (2 hours) Classification of second order equatins (2 hours) Canonical forms of hyperbolic, parabolic and elliptic equations (2 hours) The maximum principle for the heat equation, the uniqueness theorem (2 hours) Separation of variables for the heat equations, existence of solutions (4 hours) D'Alambert's solution of the wave equation (2 hours) Separation of variables for the wave equation, existence of solutions (4 hours)

<table>
<tr><td></td><td colspan="6">The maximum principle and the mean value principle for harmonic functions (2 hours)
Separation of varibles for the Laplace equation for rectangular and circular domains, existence and uniques of solutions (3 hours)
Poisson formula (1 hour)</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Class attendance and partial written exams.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td>1</td><td>Oral exam</td><td>2</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Partial written exams and final written and oral exam. Positive grade of the written exam is required to take the oral exam.</td></tr>
<tr><td rowspan="2">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Y. Pinchover, J. Rubinstein, An Introduction to Partial Differential Equations, Cambridge University Press, 2007.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">D. Bleeker, G. Csordas, Basic Partial Differential Equations, Van Nostrand Reinhold, New York, 1992.
T. Myint-U, L. Debnath, Linear Partial Differential Equations for Scientists and Engineers, 4. izdanje, Birkhauser, Boston, 2007.</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Anonymous student evaluations at the end of semester according to the regulations of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">Pedagogy of spare time</td></tr>
<tr><td>ID</td><td>PMS172</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>Antonija Bašić, pred.</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">To become aware of the importance of designing leisure time for children
and young people and their education in leisure– for leisure.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Pedagogy (79121) and Didactics (79107) passed</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1.Recognizing the space of free time as an area of relaxation, recreation
and
self-realization.
2.Recognizing free time as an area of primary prevention of behavioral
disoreders.
3.Understanding the specifics of children and young people to articulate
their leisure
4. Importance of an diversity of leisure activities and the right to choose.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1.Pedagogy of leisure time in pedagogy disciplines
2.-4. Leisure time - the concept and understanding
5.-7. The functions and types of leisure time
8-9. The characteristics of youth leisure
10-11. Peculiarities of youth and leisure
12-13. Youth activities in leisure
14. Socially desirable youth activities in the area of leisure
15. The area of leisure</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="2">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td colspan="3">☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Class attendance, the preparation and presentation of a seminar paper,
written exam or oral exam (if student wants).</td></tr>
</table>

Monitoring student work	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam	1		
	Written exam		Project			
Assessment and evaluation of student work	Class attendance and activity, the results of preliminary exams or written exam results or results of oral exam (if student wants).					
Required literature	Title				Number of copies available	Availability on other medium
	Arbunić, A. (2002.): Struktura slobodnog vremena djece (učenika) osnovnoškolske dobi. FF, Zagreb (neobjavljena doktorska disertacija).					
	Plenković, J. (2000.): Slobodno vrijeme mladeži. Sveučilište u Rijeci, Rijeka.					
Supplementary literature	Martinić, T. (1977.): Slobodno vrijeme i suvremeno društvo. Informator, Zagreb. Ilišin, V. (2001.): Djeca i mediji. Državni zavod za zaštitu obitelji, materinstva i mladeži, Zagreb.					
Quality assurance	Consultations, discussion, active participation, evaluation.					
Other (in the opinion of the proponent)	* Seminar papers are presented in seminar groups (15x1 per group) and they represent a presentation of an scientific work from the area of leisure time.					

Subject name	Short Course on Marine Data Literacy						
ID	PMP26H	Study year	2.				
Lecturer	izv. prof. dr. sc. Jadranka Šepić	Points value (ECTS)	3.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			20	0	24	0	
Subject status	Elective	Online percentage	70%				
Subject description							
Subject goals	• Acquire skills to source, use and manage ocean data proficiently • Learn about best practices on data exchange and FAIR principles including the organization, formats, documentation, storage and security of data following metadata standards • Learn about reliable data sources through a practical approach on the use of existing databases/services (especially CMEMS and EMODnet) and on how they can be accessed and used • Practise the efficient use of data in applied research and data-based assessments such as through visual analysis and professional data analysis toolboxes.						
Enrolment requirements	• Basics of programming						
Learning outcomes	• Identify different types and formats of available scientific data; • Understand the basics of data processing and extraction of knowledge from data; • Understand how relevant data may be acquired to fit the needs of users such as in fisheries resource assessment and management, water quality monitoring and the general state of health of the sea; • Give appropriate importance of data to prove theoretical concepts and/or draw scientific conclusions.						
Syllabus	1. Introduction to marine data 2. Reliable oceanographic data sources: met-ocean data sets: climate, reanalysis, forecast and in situ data 3. Online data portals 4. Accessing and transforming data 5. Reliable oceanographic data sources: Ocean remote sensing: data source, downloading and software (SNAP) 6. Applying AI to Oceanography 7. Introduction to learning algorithms, neural networks and clustering 8. Applying AI to oceanography: case studies 9. Model and satellite CMEMS data 10. Sea-level time series: detecting processes, stationarity and trends 11. Marine data visualization and analysis with Ocean Data View (ODV) 12. Marine Biogeochemistry: monitoring programs, observational platforms and associated data products 13. Oil spill detection from space with SENTINEL-1 14. Primary production time series analysis and model parameter estimation 15. Reliable oceanographic data sources: Introduction to sea state and wind wave characterization						

<table>
<tr><td></td><td colspan="6">16. Wave climate characterization</td></tr>
<tr><td>Teaching types</td><td colspan="6">☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☑ Combined online
☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring
☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Attend at least 70% of lectures and 70% of exercises.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td>1</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td>0.5</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Students are evaluated after each lecture; and after each practical session. Students need to do a research assignment within a group of international students; write a report and present results of their research.</td></tr>
<tr><td rowspan="2">Required literature</td><td>Title</td><td colspan="2">Number of copies available</td><td colspan="3">Availability on other medium</td></tr>
<tr><td colspan="6">-</td></tr>
<tr><td>Supplementary literature</td><td colspan="6"></td></tr>
<tr><td>Quality assurance</td><td colspan="6">Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6">This is a joint course of six SEA-EU Universities with lecturers coming from all seven University. The course is divided into two parts. The first introduction part consists of lectures and is held entirely on-line; the second part is practical, it consists of exercises, one is held at one of the seven Universities as an intensive training week. It is also possible to take the second part of course entirely on-line.</td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">Teaching students with special needs</td></tr>
<tr><td>ID</td><td>PMS140</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>Antonija Bašić, pred.</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Ability to develop an inclusive curriculum in primary and secondary schools</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">-language, computer and information literacy;</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Ability to work in teams in pedagogical diagnosis of special needs students
in an inclusive environment</td></tr>
<tr><td>Syllabus</td><td colspan="6">1.. Introduction to the object
2. Terminology children with special needs
3. Students with disabilities under the Ordinance on primary and secondary
education students with disabilities
4. Suitable programs for students with disabilities.
5. Regular program with an individualized approach and tailor the content
for students with sight and hearing difficulties.
6. Sixth regular program with an individualized approach and tailor the
content for students with speech and language difficulties.
7. Regular program with an individualized approach and tailor the content
for students with disabilities reading, writing and numeracy.
8. Regular program with an individualized approach and tailor the content
for students with behavioral disorders.
9. Regular program with an individualized approach and tailor the content
for students with motor impairments
10.Regular program with an individualized approach and tailor the content
for students with intellectual disabilities
11. Regular program with an individualized approach and tailor the content
for students with autistic spectrum disorders.
12. Observation techniques and methods of teaching students with
disabilities
13. Framework for the promotion and adaptation of learning experiences
and evaluation of the achievements of students with disabilities and
14.Customizing content for gifted pupils</td></tr>
</table>

	15. Framework for promoting learning experiences and evaluation of the achievements of gifted students					
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations	Students are, in accordance with the existing regulations, obliged to participate in all forms of instruction					
Monitoring student work	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam	1		
	Written exam		Project			
Assessment and evaluation of student work	Assessment of knowledge, skills and competence is carried out during the semester by evaluating students' activities during lectures and seminars, including oral examination.					

Required literature	Title	Number of copies available	Availability on other medium
	Pravilnik o osnovnoškolskom i srednjoškolskom odgoju i obrazovanju učenika s teškoćama u razvoju travanj, 2015. NN.		web
	Jensen, E. : Različita djeca različiti učenici, Educa, Zagreb,2004		
	Bouillet, D.(2010). Izazovi integriranog odgoja i obrazovanja. Zagreb: Školska knjiga.		
	Nacionalni okvirni kurikulum za predškolski odgoj i opće obvezno obrazovanje u osnovnoj i srednjoj školi. R. Hrvatska, Ministarstvo znanosti, studeni 2008		web
	Zrilić, S. (2011). Djeca s posebnim potrebama u vrtiću i nižim razredima osnovne škole. Zadar: Sveučilište u Zadru.		

Supplementary literature	Remscmidt, K, Autizam, Slap, 2008. (some chapters)
Quality assurance	Advisory hours, conversation, active participation, evaluation conducted by the Quality Assurance Board

Other (in the opinion of the proponent)	

Subject name	History of Classical Physics						
ID	PMP009	Study year	1.				
Lecturer	doc. dr. sc. Željka Sanader Maršić	Points value (ECTS)	3.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	0	0	0	
Subject status	Compulsory	Online percentage	10%				

Subject description	
Subject goals	To understand the development of physical concepts.
Enrolment requirements	None.
Learning outcomes	To be able to explain the role physical concepts in: 1. Mechanics 2. Electrodynamics 3. Thermodynamics 4. Statistical mechanics
Syllabus	The following concepts are elaborated: 1. Space, time, motion 2. Force, energy 3. Electric and magnetic field 4. Electromagnetic waves 5. Heat and temperature 6. Free energy and entropy
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring ☑ Sokratovski dijalog ☐ ☐ ☐
Student obligations	Attending all forms of teaching.

Monitoring student work						
	Class attendance	1	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	2		
	Colloquiums		Oral exam			

<table>
<tr><td></td><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Activity during classes seminar and final exam</td></tr>
<tr><td rowspan="2">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">James T. Cushing: Philosophical Concepts in Physics: The Historical Relation between Philosophy and Scientific Theories, Cambridge University Press, 1998.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">1. Peter Michael Harman: Energy, Force and Matter: The Conceptual Development of Nineteenth-Century Physics, Cambridge University Press, 1982.
2. Robert D. Purrington: Physics in the Nineteenth Century, Rutgers University Press, 1997</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Tests.
Statistics of the results of exams.
Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><th>Subject name</th><th colspan="6">History of Modern Physics</th></tr>
<tr><td>ID</td><td>PMP103</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Mile Dželalija</td><td>Points value (ECTS)</td><td colspan="4">3.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><th colspan="7">Subject description</th></tr>
<tr><td>Subject goals</td><td colspan="6">Critical understanding of historical development of basic concepts and principles in relativistic physics, quantum physics, elementary particle physics and cosmology.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Basic knowledge of relativistic physics, quantum physics, elementary particle physics, and cosmology.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Explain key conceptual elements that characterised classical mechanics, electromagnetism, thermodynamics, and historical cosmologies;
Explain philosophical and historical background for development of modern physics; Discus the contribution of main physicists to the development of special relativity, quantum physics, particle physics and cosmology;
Describe experiments and events that characterised the development of ideas and experimental techniques in special relativity, quantum physics, particle physics and cosmology;
Critically analyse conceptual evolution of knowledge in special relativity, quantum physics, particle physics and cosmology;
Discuss methods and tools for historical analyses of development of modern physics; Discuss key challenges of modern physics.</td></tr>
<tr><td>Syllabus</td><td colspan="6">(2h) Key concepts in classical mechanics, electromagnetism, thermodynamics, and historical cosmologies
(2h) Key challenges in classical physics
(2h) Selected historical experiments related to special theory of relativity
(4h) Development of new ideas, models and theories leading to special theory of relativity
(2h) Selected historical experiments related to quantum physics
(4h) Development of new idea, models and theories leading to quantum physics
(2h) Selected historical experiments related to particle physics
(4h) Development of new ideas, models and theories leading to models and theories of atoms, nucleus and elementary particles
(2h) Selected historical experiments related to development of cosmology
(2h) Development of new ideas, models and theories leading to modern cosmology
(4h) Challenges of models and theories in modern physics</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars</td><td colspan="2">☐ Fieldwork
☐ Individual assignments</td><td colspan="3">☑ Domaće zadaće</td></tr>
</table>

<table>
<tr><td></td><td colspan="2">☐ Exercises
☐ Fully online
☑ Combined online</td><td colspan="3">☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Homework assignments during semester. Written exam.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td>Domaće zadaće</td><td>1</td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>1</td><td>Završni ispit</td><td>1</td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Homework assignments during semester: 50 %; written exam: 50 %.</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">M. Dželalija: History of Modern Physics, University of Split, Faculty of Science, Split, 2020.</td><td></td><td></td></tr>
<tr><td colspan="4">Selected famous historical research articles in relativistic physics, quantum physics, particle physics and cosmology.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">James T. Cushing: Philosophical Concepts in Physics: The Historical Relation between Philosophy and Scientific Theories, Cambridge University Press, 1998. Ž. Dadić, Povijest metoda i ideja u matematici I fizici, ŠK, Zagreb, 1992. I. Supek, Povijest fizike, ŠK, Zagreb, 1980.</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Discussion with students and analysing their progress in solving problem and assignments. Statistics of exam results and evaluation of efficacy in accordance with the learning outcomes. Student evaluation by anonymous survey conducted according to the rules of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="3">Laboratory course in analytical chemistry I</td></tr>
<tr><td>ID</td><td>PMC102</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivana Mitar</td><td>Points value (ECTS)</td><td>3.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L | S | E | P
0 | 0 | 45 | 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>10%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Understand and be able to apply basic principles and safety in the laboratory and the use of classical methods of qualitative analysis.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Attending course Analytical Chemistry I.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Upon completion of the course, students will be able to:
1.organize laboratory experiments with safety measures,
2.distinguish between qualitative and quantitative analysis,
3.critically evaluate the appropriate analytical method depending on the analyte studied in the sample, and
4.evaluate and discuss the results of the analysis.</td></tr>
<tr><td>Syllabus</td><td colspan="3">EXERCISES:
1.Basic principles in the laboratory and in handling chemicals; safety measures in the laboratory
2.Correct measurement of mass/volume and sampling
3.Preparation of solutions
4.Dilution
5.Hydrolysis of salts
6.Preparation of buffer solutions
7.Qualitative analysis: Detection of cations of group I
8.Detection of cations of group II
9.Detection of cations of groups III and IV
10.Detection of cations of groups V and VI
11.Detection of anions of group I and II
12.Detection of anions of groups III and IV
13.Detection of anions of group IV
14.Separation and detection of cations and anions
15.Exercise review</td></tr>
<tr><td>Teaching types</td><td>☐ Lectures
☐ Seminars
☑ Exercises</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia</td><td>☐
☐
☐</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">☐ Fully online
☐ Combined online</td><td colspan="3">☑ Laboratory
☐ Mentoring</td><td>☐</td></tr>
<tr><td>Student obligations</td><td colspan="10">Students are required to attend laboratory practice 100 % and actively participate in the teaching process. Before each exercise, students have written or oral exam. After each laboratory exercise students are obligatory to write a report. That will be recorded and evaluated in making a final assessment.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td colspan="2">Class attendance</td><td></td><td colspan="2">Research</td><td></td><td colspan="3">Practical work</td><td>1</td></tr>
<tr><td colspan="2">Experimental work</td><td></td><td colspan="2">Paper</td><td></td><td colspan="3">Izvješće vježbi</td><td>0.5</td></tr>
<tr><td colspan="2">Essay</td><td></td><td colspan="2">Seminar paper</td><td></td><td colspan="3"></td><td></td></tr>
<tr><td colspan="2">Colloquiums</td><td>0.5</td><td colspan="2">Oral exam</td><td></td><td colspan="3"></td><td></td></tr>
<tr><td colspan="2">Written exam</td><td>1</td><td colspan="2">Project</td><td></td><td colspan="3"></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="10">All assignments for each exercise must be completed. The grade is based on the oral or written test that precedes each exercise, the student's laboratory work, the exercise reports that the student writes at the end of each exercise, and possibly the final examination of the exercises. Practical work will be graded as each exercise is performed..</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="7">Title</td><td colspan="2">Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="7">D. A. Skoog, D. M. West, F. J. Holler, Osnove analitičke kemije, Školska knjiga, Zagreb, 1999</td><td colspan="2"></td><td></td></tr>
<tr><td colspan="7">I. Mitar, Laboratorijske vježbe za kolegije iz analitičke kemije (interna, nerecenzirana skripta).</td><td colspan="2"></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="10">1.R. Kellner, J. M. Mermet, M. Otto, M. Valcarcel and H. M. Widmer, Analytical Chemistry (A Modern Approach to Analytical Science, Second Edition), Wiley-VCHVerlag Gmbh & Co. KGaA, Weinheim, 2004.
2.D. C. Harris, Quantitative Chemical Analysis, W. H. Freeman and Company, 41 Madison Avenue New York, NY, 2016.
3.B. M. Tissue, Basic of Analytical Chemistry and Chemical Equilibria, John Wiley & Sons, Inc., Hoboken, New Jersey, NY, 2013.
4.G. D. Christian, P. K. Dasgupta, K. A. Schug, Analytical Chemistry, John Wiley & Sons, Inc., 111 River Street, Hoboken, New Jersey, NY, 2014.</td></tr>
<tr><td>Quality assurance</td><td colspan="10">Quality of the teaching and learning, monitored at the level of the (1) teachers, accepting suggestions of students and colleagues, and (2) faculty, conducting surveys of students on teaching quality.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="10"></td></tr>
</table>

Subject name	Laboratory Course in Analytical Chemistry II		
ID	PMC105	Study year	2.
Lecturer	doc. dr. sc. Ivana Mitar	Points value (ECTS)	3.0
Associates		Class execution (number of hours in semester)	L: 0, S: 0, E: 45, P: 0
Subject status	Compulsory	Online percentage	10%
Subject description			
Subject goals	Adopt and understand the basics principles and application of quantitative classical methods and instrumental.		
Enrolment requirements	Attending course Analytical Chemistry II.		
Learning outcomes	Upon completion of the course, students will be able to: 1.explain the physic-chemical fundamentals of method of classical analysis, 2.distinguish methods by types of testing, 3.participate in selection of the appropriate test method according to the types of samples to be tested and 4.participate in calculation, explanation, and interpretation of the results of analyzes.		
Syllabus	EXERCISES: 1.Preparation of solutions for quantitative analysis 2.Standardization of titrants: hydrochloric acid and sodium hydroxide 3.Acidimetry: determination sample of unknown base 4.Alkalimetry: determination of oxalic acid 5.Complexometric titration: determination of ferrous ions 6.Complexometric titration: determination of magnesium ions 7.Methods based on precipitation reactions: determination of chloride ions according to Mohr method 8.Methods based on redox reactions: determination of manganese(II) ions 9.Methods based on redox reactions: Determination of copper ions 10.Gravimetric methods of analysis 11.Electrogravimetric separation of copper and nickel in the sample 12.Spectrophotometric determination of copper 13.Spectrophotometric determination of iron 14.Pigment analysis by IR spectrophotometry 15.Exercise review		
Teaching types	☐ Lectures ☐ Seminars ☑ Exercises	☐ Fieldwork ☐ Individual assignments ☐ Multimedia	☐ ☐ ☐

	☐ Fully online ☐ Combined online	☑ Laboratory ☐ Mentoring	☐

Student obligations	Students are required to attend laboratory practice 100 % and actively participate in the teaching process. Before each exercise, students have written or oral exam. After each laboratory exercise students are obligatory to write a report. That will be recorded and evaluated in making a final assessment.

Monitoring student work	Class attendance		Research		Practical work	1
	Experimental work		Paper		Izvješće vježbi	0.5
	Essay		Seminar paper			
	Colloquiums	0.5	Oral exam			
	Written exam	1.0	Project			

Assessment and evaluation of student work	All assignments for each exercise must be completed. The grade will be based on the oral or written colloquia that precede each exercise, the student's laboratory work, the exercise reports that the student writes at the end of each exercise, and possibly the final examination of the exercises. Practical work will be graded as each exercise is performed.

Required literature	Title	Number of copies available	Availability on other medium
	D. A. Skoog, D. M. West, F. J. Holler, Osnove analitičke kemije, Školska knjiga, Zagreb, 1999		
	I. Mitar, Laboratorijske vježbe za kolegije iz analitičke kemije (interna, nerecenzirana skripta)		

Supplementary literature	1.R. Kellner, J. M. Mermet, M. Otto, M. Valcarcel and H. M. Widmer, Analytical Chemistry (A Modern Approach to Analytical Science, Second Edition), Wiley-VCHVerlag Gmbh & Co. KGaA, Weinheim, 2004. 2.D. C. Harris, Quantitative Chemical Analysis, W. H. Freeman and Company, 41 Madison Avenue New York, NY, 2016. 3.B. M. Tissue, Basic of Analytical Chemistry and Chemical Equilibria, John Wiley & Sons, Inc., Hoboken, New Jersey, NY, 2013. 4.G. D. Christian, P. K. Dasgupta, K. A. Schug, Analytical Chemistry, John Wiley & Sons, Inc., 111 River Street, Hoboken, New Jersey, NY, 2014.
Quality assurance	Quality of the teaching and learning, monitored at the level of the (1) teachers, accepting suggestions of students and colleagues, and (2) faculty, conducting surveys of students on teaching quality.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="4">Laboratory in Biophysics</td></tr>
<tr><td>ID</td><td>PMP142</td><td>Study year</td><td colspan="2">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Lucija Krce</td><td>Points value (ECTS)</td><td colspan="2">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td colspan="2">L | S | E | P</td></tr>
<tr><td colspan="2">10 | 0 | 40 | 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="2">0%</td></tr>
<tr><td colspan="5">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="4">Understanding the working principles of biophysical experimental methods and techniques. Hands-on data collection in the basic operating modes of AFM, SEM, DLS and fluorescence microscope. Understanding and evaluating the obtained measurements.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="4">After passing the course, students will be able to:
1. Master the basics of handling bacterial cultures
2. measure and determine the concentration of peptides and their influence on prokaryotic and eukaryotic cells
3. Understand the working principle and application of the scanning electron microscope (SEM)
4. Analyze measurements in ImageJ and Gwyddion software
5. Understand the principle of operation and application of the transmission electron microscope (TEM)
6. Understand the principle of operation and application of the atomic force microscope (AFM)
7. Understand the principle of operation and application of a fluorescence microscope
8. To measure the Young's modulus of elasticity of human cells
9. Understand the principle of operation and application of dynamic light scattering (DLS) devices
10. Measure the size distribution of micelles using DLS</td></tr>
<tr><td>Learning outcomes</td><td colspan="4">Lectures:
(2h) basics of atomic force microscopy and application in biophysics
(1h) basics of atomic force spectroscopy and application in biophysics
(2h) basics of scanning electron microscopy and applications in biophysics
(2h) basics of transmission electron microscopy and applications in biophysics
(2h) basics of dynamic light scattering and applications in biophysics
(1h) basics of fluorescence microscopy and application in biophysics
Exercises:
Antimicrobial peptides (AMP) - measurement of concentration and activity
(4h) Design of peptides and determination of biophysical characteristics with available 'on-line' tools
(2h) Determination of peptide concentration - spectrophotometric measurement
(2h) Minimum inhibitory concentration of AMP</td></tr>
<tr><td>Syllabus</td><td colspan="4">(2h) Hemolytic activity of AMP
(1h) SEM measurements of the AFM sample</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">(3h) Preparation of bacterial samples for SEM analysis
(4h) SEM measurements of bacterial cells
(2h) Analysis of SEM data in ImageJ software
(1h) Preparation of bacterial samples for measurements on a fluorescence microscope
(1h) Measurement on a fluorescence microscope
(1h) Analysis of fluorescence images in Image software
(2h) Preparation of samples for TEM analysis and use of TEM
(1h) Preparation of human cells for AFM analysis
(4h) AFM measurements
(2h) AFM data processing in Gwyddion software
(2h) Atomic force spectroscopy on human cells
(2h) Processing of curves collected by means of atomic force spectroscopy – measurement of Young's modulus using the Hertz/Sneddon model
(1h) Sample preparation for DLS measurements
(2h) Micelle size distribution measurements by DLS.
(1h) DLS data processing.</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☐ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☑ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6"></td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>0.4</td><td>Research</td><td>0.5</td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td>1.1</td><td>Paper</td><td>2</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6"></td></tr>
<tr><td rowspan="2">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Internal materials</td><td>0</td><td>yes</td></tr>
</table>

	Scientific articles in biophysics	0	yes
Supplementary literature			
Quality assurance	Phillips, Kondev, Theriot: Physical biology of the cell, Garland Science, 2009		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="3">Laboratory in Electricity and Magnetism</td></tr>
<tr><td>ID</td><td>PMP012</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Ante Bilušić</td><td>Points value (ECTS)</td><td>3.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L S E P
0 0 40 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>20%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Understanding the laws of electromagnetism through independent performance of selected experiments.
Understanding and application of the detailed statistical analysis of experimental results</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Acquired learning outcomes in electricity and magnetism</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">1. Correctly use measuring instruments to measure charge, electric voltage, and electric current, including the oscilloscope, and explain their operation.
2. Use current- and voltage-sources correctly.
3. Design and conduct experiments that verify the laws of electromagnetism.
4. Explain the role and operation of a specific part of the experiment. Suggest possible improvements to the experiment.
5. Evaluate the accuracy of the instrument and determine the significant digits of the measurement results.
6. Calculate and discuss the contribution of random and systematic errors to the measurements and eliminate the influence of errors on the results obtained.
7. When analyzing data, identify and apply the appropriate physical model from the field of electromagnetism that explains the experimental results.
8. Through research and using additional literature, identify possible alternative physical models and discuss their application in analyzing the data obtained.
9. Write a detailed laboratory report in the form of a scientific-journal article, using the scientific method.</td></tr>
<tr><td>Syllabus</td><td colspan="3">Laboratory includes the following experiments:
• Electrical capacity of the electrometer
• Resistance measurements and Ohm’s law
• Wheatstone bridge
• RC-circuit
• RLC-circuit
• Transformer
• Interaction of the magnetic dipole moment and the magnetic field
• Magnetic induction</td></tr>
<tr><td>Teaching types</td><td>☐ Lectures</td><td>☐ Fieldwork</td><td></td></tr>
</table>

	☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online		☐ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐
Student obligations	Writing reports on the conducted experiments. Attendance.				

Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper	1.5		
	Essay		Seminar paper			
	Colloquiums		Oral exam	0.5		
	Written exam		Project			

Assessment and evaluation of student work	During each term the student's knowledge of the experiment is verbally verified, while on each performed experiment students have to write a report that will be evaluated. The exam consists in the performance of one of the experiments. The final score is based on the knowledge shown during classes and exam, and on reports on conducted experiments.		
Required literature	Title	Number of copies available	Availability on other medium
	Ante Bilušić, Praktikum iz opće fizike II, skript, in Croatian	0	yes (free access)
Supplementary literature	[1] Halliday, Resnick, Walker: Fundamentals of Physics, John Wiley & Sons, 2003.		
Quality assurance	1. Lecturers who have subjects with correlated learning outcomes work together to ensure quality of learning. 2. Statistics of test scores and assessment of performance in accordance with established learning outcomes. 3. Evaluation of students through an anonymous survey conducted in accordance with the regulations of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="5">Laboratory in Mechanics</td></tr>
<tr><td>ID</td><td>PMP011</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Ante Bilušić</td><td>Points value (ECTS)</td><td colspan="4">3.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>0</td><td>0</td><td>40</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Understanding the laws of mechanics through independent performance of selected experiments.
Understanding and application of the detailed statistical analysis of experimental results.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Acquired learning outcomes in mechanics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Correctly apply and explain the operating principle of measuring instruments used to measure length, time, mass, force, and pressure.
2. Plan and conduct experiments to verify the laws of mechanics of a material point, a solid body, and fluids.
3. Explain the role and operation of a specific part of the experiment. Suggest possible improvements to the experiment.
4. Evaluate the accuracy of the instrument and determine the significant digits of the measurement results.
5. Calculate and discuss the contribution of random and systematic errors to the measurements and eliminate the influence of errors on the results obtained.
6. When analyzing data, identify and apply the appropriate physical model from the field of mechanics that explains the experimental results.
7. Through research and using additional literature, identify possible alternative physical models and discuss their application in analyzing the data obtained.
8. Write a detailed laboratory report in the form of a scientific-journal article, using the scientific method.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Laboratory includes the following experiments:
• Length and mass measurements
• Measurement of the fluid density
• Energy conservation law
• Moment of inertia
• Pendulum with the variable constant of gravity
• Physical pendulum
• Elasticity
• Torsion pendulum
• Surface tension</td></tr>
<tr><td>Teaching types</td><td>☐ Lectures</td><td colspan="4">☐ Fieldwork</td><td></td></tr>
</table>

	☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	Writing reports on the conducted experiments. Attendance.		

Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper	1.5		
	Essay		Seminar paper			
	Colloquiums		Oral exam	0.5		
	Written exam		Project			

Assessment and evaluation of student work	During each term the student's knowledge of the experiment is verbally verified, while on each performed experiment students have to write a report that will be evaluated. The exam consists in the performance of one of the experiments. The final score is based on the knowledge shown during classes and exam, and on reports on conducted experiments.		
Required literature	Title	Number of copies available	Availability on other medium
	Ante Bilušić, Praktikum iz opće fizike I, script, in Croatian	0	yes (free access)
Supplementary literature	[1] Antonije Dulčić, Miroslav Požek, Nikola Poljak: Mehanika, Školska knjiga, Zagreb, 2023., in Croatian [2] Halliday, Resnick, Walker: Fundamentals of Physics, John Wiley & Sons, 2003.		
Quality assurance	1. Lecturers who have subjects with correlated learning outcomes work together to ensure quality of learning. 2. Statistics of test scores and assessment of performance in accordance with established learning outcomes. 3. Evaluation of students through an anonymous survey conducted in accordance with the regulations of the University of Split.		
Other (in the opinion of the proponent)			

Subject name	Laboratory in Modern Physics		
ID	PMP20F	Study year	1.
Lecturer	doc. dr. sc. Lucija Krce	Points value (ECTS)	3.0
Associates		Class execution (number of hours in semester)	L: 0, S: 0, E: 40, P: 0
Subject status	Elective	Online percentage	0%

Subject description

Subject goals	Understanding the laws of modern physics through the independent performance of selected experiments. Understanding and applying statistical analysis of experimental results. Computer application in statistical processing of results.
Enrolment requirements	None
Learning outcomes	by applying knowledge from modern physics to understand the theoretical background of selected experiments using the understanding of modern physics to describe the parts and principles of operation of selected experiments by applying knowledge in the field of measurement in physics and by applying computers, statistically analyze the results obtained by measurements, by using knowledge in the field of measurement in physics and based on the results of statistical analysis to identify and understand measurement errors
Syllabus	Specific charge of an electron Hall effect Planck's law of radiation Measurement of the Planck constant Temperature dependence of resistance of conductors and semiconductors Determination of silver nanoparticle size by UV-VIS spectroscopy
Teaching types	[ ] Lectures [ ] Seminars [ ] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [ ] Individual assignments [ ] Multimedia [x] Laboratory [ ] Mentoring
Student obligations	Writing reports on the conducted experiments. Attendance.

Monitoring student work

Class attendance	1	Research		Practical work	
Experimental work		Paper	1.5		
Essay		Seminar paper			
Colloquiums		Oral exam	0.5		

	Written exam		Project			

Assessment and evaluation of student work	During each term the student's knowledge of the experiment is verbally verified, while on each performed experiment students have to write a report that will be evaluated. The exam consists in the performance of one of the experiments. The final score is based on the knowledge shown during classes and exam, and on reports on conducted experiments.		
Required literature	Title	Number of copies available	Availability on other medium
	Internal script		yes
Supplementary literature	Halliday, Resnick, Walker: Fundamentals of Physics, John Wiley & Sons, 2003. Scientific journals in physics education		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Practical Skills in Molecular Genetics</td></tr>
<tr><td>ID</td><td>PPB282</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Željana Fredotović</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>0</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Teach students basic molecular genetics methods. Introduce students with the role of molecular genetics in biology, medicine and biotechnology.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Student will be able to:
1. apply theoretical knowledge on bioinformatic datebases,
2. design primers for polymerase chain reaction (PCR)
3. perform polymerase chain reaction and gel elctrophoresis after PCR
amplification
4. perform RNA isolation and analysis
5. synthesize cDNA
6. compare the application of conventional and real-time PCR
7. interpret and analyse results of PCR reaction
8. work on fluorescence microscope</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures:
1. Determination of cytoplasmic genotype of Allium x cornutum
Exercises:
1. PART1_Primer Blast- primer design (2 hours). Students will learn to design primers according to the DNA sequence. They will learn to calculate the Tm melting temperature, possibility for primer dimer formation and percentage of GC pair base
2. PCR amplification of chloroplast genes (2 hours). Students will know to describe the polymerase chain reaction process, they will be able to
amplificate the cytoplasmic gene matK
3. Agarose gel electrophoresis of PCR products following DNA amplification (2 hours). Students will be able to explain the principle of gel electrophoresis, calculate accurate volume of all the buffers and agarose and will know to prepare the agarose gel by themselves, put the samples on gel and interpret the results.
4. DNA gel extraction and purification (2 hours). Student will learn to purify DNA fragments using the commercial kit.
5. PART 2_Single cell gel electrophoresis assay. Preparation of solutions and microscope slides (4 hours). Students will know how to handle with the</td></tr>
</table>

	laboratory equipment. They will know how to calculate the accurate concentrations of solutions. They will be able to prepare the microscopic slides precoated in agarose. 6. Cell isolation and treatment (2 hours). Students will know how to put the cells on precoated microscopic slides 7. Electrophoresis and staining of microgel slides (2 hours). Students will be able to explain the electrophoresis process on microscopic slides. They will be able to prepare the electrophoretic chamber for the electrophoresis and to calculate the accurate power and voltage. 8. Evaluation of DNA damage (2 hours). Students will have to understand the role of fluorescent dye (DAPI) that we use for staining the microscopic slides. They will able to use the epifluorescence microscope and know how to interpret the results. 9. PART 3_Gene expression analysis using real-time PCR. Isolation and cultivation of peripheral blood leukocytes (2 hours). Students will be able to explain the procedure of isolation and cultivation of leukocytes. 10. RNA isolation and electrophoresis (2 hours). Students will learn how to isolate and analyse RNA from leukocytes and to determine the RNA purity and concentration. Perform the electrophoresis of RNA samples 11. Reverse trancription polymerase chain reaction (RT-PCR), electrophoresis and purification of amplified genes (4 hours). Student will learn the basics of reverse transcription of RNA and formation of cDNA, amplification of cDNA samples, analyse the samples on gel electrophoresis, purification of DNA fragments as they learned in exercise 4. 12. Quantitative real-time polymerase chain reaction (real-time PCR) (2 hours). Student will know the basics of real-time pcr method, they will also know why we use fluorescent dye for labelling the cDNA (SYBR Green). They will be able to perform the amplification reaction by themselves and interpret the results. They will be able calculate the fold change to every analysed gene.
Teaching types	☐ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☑ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Students must attend all lab exercises. They must carry the lab coat, script, pencil and calculator.

Monitoring student work

Class attendance		Research		Practical work	
Experimental work	1.0	Paper			
Essay		Seminar paper			
Colloquiums		Oral exam	1.0		
Written exam		Project			

Assessment and evaluation

of student work	Evaluation of homework and final oral exam		
Required literature	Title	Number of copies available	Availability on other medium
	Metode u molekularnoj biologiji. 2007. Andreja Ambriovič Ristov (ur). Institut Ruđer Bošković.		
	Puizina, J. 2005: Practical exercises in molecular biology, internal script		web
	Fredotović, Ž. 2016 Practical Skills in Molecular Genetics, internal script		web
Supplementary literature			
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="3">Laboratory Course in Organic Chemistry</td></tr>
<tr><td>ID</td><td>PMC007</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Renata Odžak
izv. prof. dr. sc. Stjepan Orhanović</td><td>Points value (ECTS)</td><td>4.5</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 0, S: 0, E: 60, P: 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>10%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Introduce modern techniques and methods of work in organic chemistry.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Listened Organic chemistry I and enrolled Organic Chemistry II.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">After completing the course, the students will be able to:
1. use an apparatus for organic synthesis,
2. to distinguish between functional groups of organic compounds and the ways of their demonstration,
3. apply the extraction method,
4. interpret the results of the product synthesis from the given reactants with the calculation of utilization,
5. apply contemporary techniques of purification of organic preparations and devices in the laboratory for organic chemistry.</td></tr>
<tr><td>Syllabus</td><td colspan="3">Laboratory exercises:
1. Preparation of solutions and reagents (4 hours)
2. Determination of Functional Group of Organic Compounds (4 hours)
3. Separation of the mixture by extraction (4 hours)
4. Separation by column and thin layer chromatography (4 hours)
5. cis-trans isomerism (4 hours)
6. Electrophilic addition (8 hours)
7. Organic reactions of preparation and identification of compounds: Fischer esterification (methyl benzoate) (4 hours)
8. Grignard reaction (triphenylmethanol) (4 hours)
9. Electrophilic substitution of benzene derivatives (p-nitroacetanilide) (4 hours)
10. Isolation and conversion of compounds with their identification: caffeine from tea (4 hours), milk casein (4 hours) and oleic acid from oil (4 hours)
13. Diels-Alder reaction of conjugated dienes in eucalyptus oil (4 hours)
14. Compensation for unfinished exercises (4 hours)</td></tr>
<tr><td>Teaching types</td><td>☐ Lectures
☐ Seminars
☑ Exercises</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia</td><td>☐
☐</td></tr>
</table>

	☐ Fully online ☐ Combined online		☐ Laboratory ☐ Mentoring			☐ ☐
Student obligations						
Monitoring student work	Class attendance		Research		Practical work	
	Experimental work	1.0	Paper			
	Essay		Seminar paper			
	Colloquiums	1.0	Oral exam			
	Written exam	2.5	Project			
Assessment and evaluation of student work	All exercises must be collapsed and made. The entrance exam is placed before the exercise, and the students work in the laboratory during the same work. Students are obliged to keep a diary in which they enter the results of the experiment. The final written exam of the student is accesses after the exercises are done and the reviewed work journal. For the passing grade, at least 50% of the final exam is needed.					
Required literature	Title				Number of copies available	Availability on other medium
	Internal Script for Laboratory Exercises					
Supplementary literature						
Quality assurance	Consultations, student surveys for subject and teacher evaluation, attendance records, and analysis of the success of the colloquium and final exams.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">Laboratory in Thermodynamics and Modern Physics</td></tr>
<tr><td>ID</td><td>PMP014</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Lucija Krce</td><td>Points value (ECTS)</td><td colspan="4">3.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>0</td><td>0</td><td>40</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Understanding the lows of thermodynamics through independent performance of selected experiments.
Understanding and application of the detailed statistical analysis of experimental results.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Acquired learning outcomes in thermodynamics and modern physics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Correctly use calorimeters, thermometers, vacuum pumps, and radiation intensity meters and explain their operation
2. Design and conduct experiments that test the laws of thermodynamics and modern physics.
3. Explain the role and operation of a specific part of the experiment. Suggest possible improvements to the experiment.
4. Evaluate the accuracy of the instrument and determine the significant digits of the measurement results.
5. Calculate and discuss the contribution of random and systematic errors to the measurements and eliminate the influence of errors on the results obtained.
6. When analyzing data, identify and apply the appropriate physical model from the field of thermodynamics and modern physics.
7. Through research and using additional literature, identify possible alternative physical models and discuss their application in analyzing the data obtained.
8. Write a detailed laboratory report in the form of a scientific-journal article, using the scientific method.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Laboratory includes the following experiments:
• Equation of state of ideal gas
• Thermal expansion of the solid body
• Specific heat capacity of water
• Specific heat of ice melting and water evaporation
• Specific heat capacity of the solid body
• Maxwell-Boltzmann distribution of velocities
• Solar cells characteristics
• Thermal conduction of metals</td></tr>
<tr><td>Teaching types</td><td>☐ Lectures</td><td>☐ Fieldwork</td><td colspan="4"></td></tr>
</table>

	☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	Writing reports on the conducted experiments. Attendance.		

Monitoring student work						
	Class attendance	1	Research		Practical work	
	Experimental work		Paper	1.5		
	Essay		Seminar paper			
	Colloquiums		Oral exam	0.5		
	Written exam		Project			

Assessment and evaluation of student work	During each term the student's knowledge of the experiment is verbally verified, while on each performed experiment students have to write a report that will be evaluated. The exam consists in the performance of one of the experiments. The final score is based on the knowledge shown during classes and exam, and on reports on conducted experiments.

Required literature	Title	Number of copies available	Availability on other medium
	Ante Bilušić, Larisa Zoranić Praktikum iz opće fizike IV, skripta, in Croatian	0	yes (free access)

Supplementary literature	[1] Halliday, Resnick, Walker: Fundamentals of Physics, John Wiley & Sons, 2003.
Quality assurance	1. Lecturers who have subjects with correlated learning outcomes work together to ensure quality of learning. 2. Statistics of test scores and assessment of performance in accordance with established learning outcomes. 3. Evaluation of students through an anonymous survey conducted in accordance with the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="7">Laboratory in Waves and Optics</td></tr>
<tr><td>ID</td><td>PMP013</td><td>Study year</td><td colspan="5">3.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Lucija Krce</td><td>Points value (ECTS)</td><td colspan="5">3.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td colspan="2">P</td></tr>
<tr><td>0</td><td>0</td><td>40</td><td colspan="2">0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="5">20%</td></tr>
<tr><td colspan="8">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="7">Understanding the wave laws and optics through independent performance of selected experiments.
Understanding and application of the detailed statistical analysis of experimental results.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="7">Acquired learning outcomes in waves and optics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="7">1. Correctly apply and recognize lens systems.
2. Correctly apply and explain the operation of devices that operate on the principles of wave refraction (e.g., optical prism), wave diffraction (e.g., optical grating), and sources of various waves (e.g., light and mechanical).
3. Understand the spectra of light sources.
4. Design and conduct experiments that test the laws of wave propagation and geometrical and physical optics.
5. Explain the role and operation of a specific part of the experiment. Suggest possible improvements to the experiment.
6. Evaluate the accuracy of the instrument and determine the significant digits of the measurement results.
7. Calculate and discuss the contribution of random and systematic errors to the measurements and eliminate the influence of errors on the results obtained.
8. When analyzing data, identify and apply the appropriate physical model from the field of wave propagation and geometrical and physical optics.
9. Through research and using additional literature, identify possible alternative physical models and discuss their application in analyzing the data obtained.
10. Write a detailed laboratory report in the form of a scientific-journal article, using the scientific method.</td></tr>
<tr><td>Syllabus</td><td colspan="7">Laboratory includes the following experiments:
• Standing waves
• Refraction of light on the spherical surface – lenses
• Newton’s rings
• Dependence of the refractive index on the frequency of light
• Resolving power of the optical grating
• Fresnel’s equations of the light refraction
• Diffraction of sound wave on a slit</td></tr>
</table>

Teaching types	☐ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations	Writing reports on the conducted experiments. Attendance.					
Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper	1.5		
	Essay		Seminar paper			
	Colloquiums		Oral exam	0.5		
	Written exam		Project			
Assessment and evaluation of student work	During each term the student's knowledge of the experiment is verbally verified, while on each performed experiment students have to write a report that will be evaluated. The exam consists in the performance of one of the experiments. The final score is based on the knowledge shown during classes and exam, and on reports on conducted experiments.					
Required literature	Title				Number of copies available	Availability on other medium
	Ante Bilušić, Larisa Zoranić Praktikum iz opće fizike III, skript, in Croatian				0	yes (free access)
Supplementary literature	[1] Halliday, Resnick, Walker: Fundamentals of Physics, John Wiley & Sons, 2003.					
Quality assurance	1. Lecturers who have subjects with correlated learning outcomes work together to ensure quality of learning. 2. Statistics of test scores and assessment of performance in accordance with established learning outcomes. 3. Evaluation of students through an anonymous survey conducted in accordance with the regulations of the University of Split.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">Applied Statistics</td></tr>
<tr><td>ID</td><td>PMIG10</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Goran Erceg</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The course objective is to introduce students to the fundamentals of statistical theory and methods, and to teach them practical skills required for statistical analysis and interpretation of results.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">The student is able to:

group gathered statistical data and display them in tables or by using graphical means,

analyse statistical data,

calculate all parameters for given statistical data and interpret their values,

define all basic notions of statistics and probabilty theory,

solve problems of mid range difficulty from the fundamentals of probability theory,

explain and apply all basic statistical tests,

interpret the results of the basic tests.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Statistical populations and statistical variables: frequencies and proportions, classification of qualitative and numerical data (3 hours).

Population parameters: arthimetic mean, standard deviation, standardized statistical variable, geometric and harmonic mean, moments, measures of position (4 hours).

Random experiments: outcomes, operations with outcomes, outcome probability, probability space (discrete and general) (2 hours).

Normal, student and chi-squared distribution, conditional probability, independent events, Bayes' formula (3 hours).</td></tr>
</table>

	Discrete random variables: the Bernoulli experiment and distribution, the Poisson, hypergeometric, geometric and Pascal distribution (3 hours). Continuous random variable: density function, expectation, variance (2 hours). Two dimensional random variable: marginal distributions, conditional distributions, independence, covariance and the correlation coefficient (2 hours). Samples, estimators for a population parameters (2 hours) Confidence intervals: arithmetic mean estimates, proportion estimates, variance estimates, testing two means (variances, proportions) (3 hours) Hypothesis testing, significance level, : Z-test and t-test, testing the variance hypothesis, nonparametric tests (6 hours).
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Class and tutorial sessions attendance, solving homework problems, self-learning of prescribed material by using the obligatory and optional literature.

Monitoring student work

Class attendance	1	Research		Practical work	
Experimental work		Paper		Ispit	5
Essay		Seminar paper			
Colloquiums		Oral exam			
Written exam		Project			

Assessment and evaluation of student work	Final written and oral exam. Positive grade at the written exam is required to take the oral exam. The written and oral exam are equally weighted in the final grade.

Required literature

Title	Number of copies available	Availability on other medium
N. Koceić Bilan, Primijenjena statistika, skripta PMF Split (2011)		da

Supplementary literature	I. Šošić, Primijenjena statistika , Školska knjiga Zagreb, 2. izdanje (2006) Ž. Pauše, Uvod u matematičku statistiku, Školska knjiga Zagreb (1993)
Quality assurance	Anonymous student evaluations at the end of semestar according to the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Application of Programming in Physics</td></tr>
<tr><td>ID</td><td>PMP074</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Žarko Kovač
doc. dr. sc. Toni Šćulac</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The course aims to teach students the application of numerical problem-solving in physics. The goal is to enable students to develop algorithms for numerical problem-solving in physics through various examples.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">• Develop or adapt existing algorithms for modeling simple processes and performing calculations, and present solutions graphically.
• Extract parts of an algorithm into separate units and implement them as subprograms or functions with an appropriate method of argument transfer, using libraries and modules.
• Choose an appropriate data record structure for storing data in files on a local or remote computer (repository).
• Format the given problem in a way suitable for computer analysis, using physics concepts and laws, and mathematical analysis.
• Assess and minimize numerical errors and discuss the criteria for applying and limiting some numerical methods.
• Visualize data to facilitate interpretation and formulate data dependence by adjusting a mathematical function to that data.
• Define a model (deterministic, stochastic, or statistical) for the given problem, write a computer program, perform a simulation, and present the results.</td></tr>
<tr><td>Syllabus</td><td colspan="6">(2+2) Introduction, Python Review
(2+2) Modules and Simple Motions
(2+2) Object-Oriented Approach to Algorithm Development
(2+2) Numerical Differentiation and Integration
(2+2) Euler's Method
(2+2) Algorithm for Statistical Data Processing
(2+2) Projectile Motion and Runge-Kutta (RK) Method
(2+2) Understanding Errors in Euler's and RK Methods
(2+2) Modeling Bungee Jumping
(2+2) Modeling of Charged Particle in EM Field
(2+2) Gravitational Interaction of 2 Bodies
(2+2) Gravitational Interaction of N Bodies</td></tr>
</table>

	(2+2) Numerical Modeling of Solar System (2+2) Complex Modeling of Multi-Body Problems (Part 1) (2+2) Complex Modeling of Multi-Body Problems (Part 2)
Teaching types	[x] Lectures [ ] Seminars [x] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [x] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring [ ] [ ] [ ] [ ]
Student obligations	1. Actively participate in class by critically evaluating and arguing opinions, asking and answering questions. 2. Solve assigned problems in waves and optics. 3. Critically discuss selected concepts and laws and their applicability.
Monitoring student work	(see table below)
Assessment and evaluation of student work	The solutions to exercise tasks and the final seminar paper are being evaluated.
Required literature	(see table below)
Supplementary literature	1) Numerical Recipes in C and C++, The Art of Scientific Computing, Press, Teukolsky, Vetterling and Flannery, Cambridge University Press, 1993. 2) An Introduction to Computational Physics, Tao Pang, Cambridge University Press, 2006.
Quality assurance	1. Lecturers who have subjects with correlated learning outcomes work together to ensure quality of learning. 2. Statistics of test scores and assessment of performance in accordance with established learning outcomes. 3. Evaluation of students through an anonymous survey conducted in accordance with the regulations of the University of Split.

Monitoring student work:

Class attendance	2	Research		Practical work	1.5
Experimental work		Paper			
Essay		Seminar paper	1.5		
Colloquiums		Oral exam			
Written exam		Project			

Required literature:

Title	Number of copies available	Availability on other medium
Harvey Gould, Jan Tobochnik, and Wolfgang Christian „An Introduction to Computer Simulation Methods Applications to Physical System“, Addison-Wesley, 2006.		
A. B. Shiflet and G. W. Shiflet "Introduction to computational science", Princeton University Press, 2006.		

Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Natural Science and the Environment</td></tr>
<tr><td>ID</td><td>PMP162</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivana Weber</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>10</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">To understand and apply fundamental physical concepts, laws and approaches in physics and interdisciplinary with other disciplines on the environment.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">No</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">· Explain and apply the basic thermodynamics to the human environment
· Explain the basic composition, structure and dynamics of the atmosphere
· Explain the operation of the hydrologic cycle and discuss the mechanisms of water transport in the atmosphere and in the ground
· Discuss specific environmental problems such as noise pollution, ozone depletion and global warming in the context of an overall understanding of the environment and the application of the laws in physics
· Discuss the problems of energy demand and explain the possible contributions of renewables to energy sources
· Understand other environmental issues in relation to laws of physics (selected by students)</td></tr>
<tr><td>Syllabus</td><td colspan="6">(5) Application of the laws of thermodynamics
(5) Energy transfers
(2) Noise pollution
(2) Structure and comosition of the atmosphere
(2) Ozone in the atmosphere
(2) Greenhouse effect
(2) Earth radiation
(2) Global warming
(5) Water in the atmosphere and clouds
(5) Physics of wind creation
(2) Physics of ground
(2) Energy demand
(2) Renewable energy resources
(2) Selected topics</td></tr>
<tr><td>Teaching types</td><td></td><td></td><td colspan="4">☑ Predavanja</td></tr>
</table>

	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	korištenjem prezentacija i rasprava sa studentima. ☑ Rješavanje odabranih jednostavnih primjera, samostalno i u grupi, ☑ Studentske prezentacije i rasprave pojedinih tema na seminaru. ☐
Student obligations	Active participation on classes and assignments. Prepare and present a seminar on a selected topics Solve the given numerical problems by using the concepts and laws from physics Critically discuss selected concepts and laws and their applicability		

Monitoring student work	Class attendance		Research		Practical work	
	Experimental work		Paper		aktivno sudjelovati u nastavi svojim komentarima, pitanjima i odgovorima na pitanja – pripremiti i prezentirati seminarski rad o odabranoj temi – riješiti zadane numeričke zadatke primijenjujući pojmove i zakone u navedenim sadržajima – kritički raspraviti odabrane pojmove i zakone te njihovu primjenjivost	2
	Essay		Seminar paper	2		
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	Preparation and presentation of seminars (50%) Critical discussion of concepts and laws (40%) Solve simple numerical problems (10%) The final grade is formed according to the following list: [50,60>% = D (2) [60,75>% = C (3) [75,90>% = B (4) [90,100]% = A (5)		
Required literature	Title	Number of copies available	Availability on other medium
	Nigel Mason and Peter Hughes: Introduction to Environmental Physics: Planet Earth, Life and Climate, Taylor and Francis, 2001.		
	M. Dželalija, Environmental Physics, Skripta, 2004.		
Supplementary literature	Presentations, examples and course book, M. Dželalija By choice from various disciplines with topics on the environment		
Quality assurance	– Analysis of achieved learning outcomes at the end of the class, compared to those at the beginning of the class – Monitoring the success of students in the following subjects – Other surveys of students according to the rules of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="3">Natural toxins in the sea</td></tr>
<tr><td>ID</td><td>PPC210</td><td>Study year</td><td>3.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Stjepan Orhanović</td><td>Points value (ECTS)</td><td>2.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L S E P
15 0 0 0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>10%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Course objective is acquiring knowledge about various sources of toxicity originating in the sea and their influence on the human health</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Upon completing exam student will be able to:
1.recognize sources of toxicity in the marine environment
2.comprehend influence of the toxicity originating from phytoplanktons on the shellfish farming and humans
3.acquire insight in frequency and spatial distribution of the phytoplankton species responsible for shellfish intoxication in the Adriatic sea
4.know methods and techniques of analysis of the shellfish toxicity</td></tr>
<tr><td>Syllabus</td><td colspan="3">Lectures:
1.Eutrophication and the red tide (1 hour)
2.Phytoplankton species - producers (1 hour)
3.Diarrheic toxins (2 hours)
4.Paralytic toxins (2 hours)
5.Neurotoxins (2 hours)
6.ASP (2 hours)
7.Cyanotoxins, azaspiroid intoxication (1 hour)
8.Ciguatera intoxication (1 hour)
9.Analytical methods: Mousse bioassay, HPLC, mass spectrometry, MALDI-TOF (2 hours)
10.Overview of the present state in the Adriatic (1 hour)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Attending classes and preparing seminar as a PPT presentation.</td></tr>
</table>

<table>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>0.5</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>1</td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Power point presentation on the chosen subject with reflection on the causes, influence, frequency and spatial distribution of intoxication and related analytical methods</td></tr>
<tr><td rowspan="2">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Scientific articles on the subject presented</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6"></td></tr>
<tr><td>Quality assurance</td><td colspan="6">Personal consultations, students survey for the evaluation of the subject and teacher, evidence of the presence on the classes.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="7">Network Application Programming</td></tr>
<tr><td>ID</td><td>PMIC60</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>Dino Nejašmić, pred.</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">This subject begins with an in-depth study of XHTML, the universal language of the Web. CSS is studied as it relates to enhancing the presentation of web content. Client-side programming is taught using JavaScript and the DOM, technologies used to create dynamic content and provide a true interactive experience for the Web site visitor. Course continues by addressing the technical skills and business knowledge required to develop data-driven web sites hosted on the Microsoft Web Platform. The course continues to focus on server-side ASP.NET programming technologies and the C# language. Students work with current and full-featured data access technologies, and interact with a local database.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Basic knowledge of programming.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon successful completion of this subject students should be able to:
1. Analyze a given problem, and use JavaScript to program a browser-based solution to that problem.
2. Explain key design concepts essential to communicating with web site users.
3. Combine XHTML, CSS, and JavaScript to create dynamic web pages and integrated web sites.
4. Analyze the requirements for a web-enabled application, and use both ASP.NET and web client technologies to program a solution to the problem.
5. Use the design and productivity tools provided with Visual Studio
6. Design a suitable data access strategy, and use the appropriate technologies to work with the data</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Introduction to the Internet (2h)
2. Introduction to HTML/XHTML (2h)
3. Web Site Design (2h)
4. JavaScript (6h)
5. Dynamic Content with JavaScript (2h)
6. Midterm
7. ASP.NET technologies (2h)
8. ASP.NET user interface controls (2h)
9. Web applications (2h)
10. Data-driven web applications (2h)
11. Multilanguage support (2h)
12. Stored procedures in web applications (2h)</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">13. Security challenges in web application (2h)
14. Project (2h)</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Lecture and laboratory attendance, active participation in course activities, homework and project realization, final exam.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td>2</td><td>Project</td><td>2</td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Attendance/Participation (20%)
Project (40%)
Final/Oral Exam (40%)</td></tr>
<tr><td rowspan="4">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Osnove programiranja za web, Sveučilište u Splitu Filozofski fakultet, 2007. Lada Maleš, Saša Mladenović</td><td></td><td></td></tr>
<tr><td colspan="4">JavaScript: The Definitive Guide, David Flanagan, O'Reilly (2011.)</td><td></td><td></td></tr>
<tr><td colspan="4">Beginning ASP.NET 4.5 in C# Matthew MacDonald (2012.)</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Online Student material, including solutions to selected problems and additional reading</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Student discussion, anonymous student evaluation questionnaire, student success rate, self-assessment</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="3">Applied spatial statistics</td></tr>
<tr><td>ID</td><td>PMM501</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Vesna Gotovac Đogaš</td><td>Points value (ECTS)</td><td>5.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 30, S: 0, E: 30, P: 0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>10%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">The aim of the course is to introduce students with the fundamentals of statistical analysis for spatial data. The emphasis is on statistical analysis of real data examples using programming language R.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">The student must have completed the following course: Probability I
Previous knowledge required: Students should have a basic background in statistics and programing.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">1. Distinguish different types of spatial data,
2. determine which spatial methods to use to in their own research and implement them using statistical software R,
3. estimate parameters of different statistical models,
4. understand how spatial autocorrelation plays a role in statistical modelling and use existing methods to investigate spatial autocorrelation in example datasets provided.</td></tr>
<tr><td>Syllabus</td><td colspan="3">Introduction. Examples of statistical problems in spatial data analysis. (2)
Types of spatial data (4)
Statistics of point processes. Estimation of characteristics. Hypothesis testing. Model parameter estimation. (8)
Geostatistics. Estimation of variogram. Kriging. (8)
Areal data. Parameter estimation. Spatial autocorrelation tests. (8)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Class attendance and taking partial and final exams.</td></tr>
<tr><td>Monitoring student work</td><td colspan="3">
<table>
<tr><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
</table>
</td></tr>
</table>

Assessment and evaluation of student work	Partial exams, written exam and oral exam.		
Required literature	Title	Number of copies available	Availability on other medium
	Bivand R.S, Pebesma E.J., Gómez-Rubio V. : Applied Spatial Data Analysis with R. Sprin		
Supplementary literature	Cressie N.A.C.: Statistics for Spatial Data. Wiley, 1993. Illian J., Penttinen A., Stoyan H., Stoyan D.: Statistical Analysis and Modelling of Spatial Point Patterns. Wiley, 2008. Moller J., Waagepetersen R. P.: Statistical Inference and Simulation for Spatial Point Processes. Chapman&Hall/CRC, 2003 Schabenberger O., Gotway C.: Statistical Models for Spatial Data Analysis. Chapman&Hall/CRC, 2005		
Quality assurance	Student evaluations following completion of the course. The evaluations are administered according to the regulations of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Quantum Physics II</td></tr>
<tr><td>ID</td><td>PMP200</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Leandra Vranješ Markić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Extend students' ability in applying the basic formalism of quantum mechanics to understanding and predicting the behavior of physical systems for which the Schrodinger equation cannot be analytically solved, such as multielectron atoms. Understanding and applying interference calculations, solving scattering problems. Introduce students to concepts that will allow them to monitor new results related to the interpretation and modern applications of quantum mechanics.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Knowledge of basic concepts of quantum mechanics and ability to apply to simple problems and the hydrogen atom.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. understand the concept of spin angular momentum, its quantisation and addition rules,
2. explain the Zeeman effect and spin-orbit coupling,
3. describe and apply the basic techniques of time-dependent and independent perturbation theory,
4. understand and apply the variation principle,
5. apply an appropriate method in solving the scattering problems,
6. define the concepts of identical particles, quantum statistics and understand the role of quantum statistics, especially in the periodic table of elements,
7. perform calculations with a system of identical particles, such as determining the symmetry of the wave function, the total spin,
8. explain the physical properties of atoms and molecules based on quantum mechanics,
9. understand quantum coupling and measurement problems and modern applications of quantum mechanics: quantum computing, quantum teleportation and quantum cryptography.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Spin. Operators. Matrix representation. Addition of angular moments. 8 hours
2. Zeeman effect. 4 hours
3. Time-independent perturbation, non-degenerate and degenerate systems. 6 hours
4. Application of perturbation theory: Stark effect. Fine and hyperfine structure. 4 hours
5. Variation principle. Application to a helium atom. 4 hours
6. Time-dependent perturbation. Application: selection rules for electromagnetic radiation. 8 hours
7. Scattering theory. Bourne approximation. Partial wave method. 8 hours
8. Multiparticle Schroedinger equation. Wave function of identical particles. 4 hours
9. Multielectron atoms. Helium atom. Periodic table of the elements. 4 hours
10. Hydrogen molecule. Molecular spectra. 4 hours</td></tr>
</table>

	11. Quantum coupling. EPR argument. Bell's inequalities. Schroedinger's cat. 3 hours 12. Quantum teleportation. Quantum cryptography. Elements of quantum computational theory. 3 hours
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Active participation in the classes

Monitoring student work						
Class attendance	1.5	Research		Practical work	
Experimental work		Paper		Independent work	4.5
Essay		Seminar paper			
Colloquiums		Oral exam			
Written exam		Project			

Assessment and evaluation of student work	Written exam (or colloquia) and oral.

Required literature

Title	Number of copies available	Availability on other medium
N. Zettili, "Quantum mechanics: concepts and applications"	0	
Various websites with solved examples in quantum mechanics.	0	
Popular and scientific articles and presentations (quantum coupling, quantum cryptography, teleportation, quantum computing).	0	

Supplementary literature	[1] R. Scherrer „Quantum mechanics: An Accessible Introduction“. [2] R. L. Liboff, „Introductory Quantum Mechanics“. [3] Auletta, Genaro, Parisi, “QuantumMechanics”. [4] D. J. Griffits, “Introduction to QuantumMechanics”.
Quality assurance	Monitoring success in colloquia and exams. Discussion with students and analysing their progress in solving problem and assignments. Student evaluation by anonymous survey conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

Subject name	Computer vision						
ID	PMII60	Study year	2.				
Lecturer	doc. dr. sc. Barbara Džaja	Points value (ECTS)	5.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	0	30	0	
Subject status	Elective	Online percentage	0%				
Subject description							
Subject goals	Adopt basic knowledge about the elements of the system, algorithms and methods used in computer vision applications. Independent student's ability to adapt and apply computer vision algorithms for specific problem.						
Enrolment requirements	Course enrolment requirements: none.						
Learning outcomes	After this course, students will be able to: - Analyze and identify a given problem in the field of computer vision - Classify algorithms of computer vision - Identify the types of images - Write algorithm for image processing in Python using OpenCV library - Identify the method of processing for a given problem - Apply the algorithm to its own problem						
Syllabus	An introductory lecture, introducing students to the rules of the class rules attendance, Introduction to the computer vision, an overview of the program, learning objectives and tasks of students. Introduction to literature Introduction to Python and libraries that will be used. How to install plug-ins that are required for image processing. Picture, cameras, models, calibration, perception of light Exercise 1. Basic manipulation with images The basic relations between the pixels, processing of binary images Exercise 2. Advanced manipulation with images The projections, length coding algorithms and binary (filter size, Euler number, the edge region, area, perimeter, compactness, transformation distance, the central axis, thinning, expansion and contraction) Exercise 3. Mathematical operations on the image Morphological operators, basic operations, dilation, erosion, closing, opening, binary morphology, Exercise 4. Image processing Improving the properties of gray images, the exponential transformation, histogram modeling, linear filters (convolution, filter spatial averaging, Gaussian filter, Median filter). Exercise 5. Image derivation Filtering in the frequency domain - Fourier transform						

<table>
<tr><td></td><td colspan="6">1st colloquium
Image segmentation
Exercise 6. Morphological operators – Objects labeling
Image segmentation – edge detection, gradient operators, operators of other derivatives, log detector edge, Canny edge detector
Exercise 7. Morphological operators – dilation, erosion, opening and closing
Textures and colors in images, color models, the physiology of the eye
Exercise 8. OpenCV
3D space points in 3D space, transformation of coordinate system, internal orientation and calibration
Exercise 9. OpenCV – Arithmetic operations on images
Objects in motion – detection of changes and segmentation based on changes
Exercise 10. OpenCV – Finding and marking objects
Objects in motion – tracking of moving objects
Exercise 11. OpenCV – Working with video
Object recognition
Exercise 12th OpenCV – Tracking objects
Student papers and the second colloquium</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☑ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Class attendance
Independently preparation of exercise.
Making exercise reports
Independent planning and presentation of student paper
Active participation in the teaching process
Exam.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>1</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>2</td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Total scoring (100%):
Exam or 2 colloquiums – 80%, student paper 10%, exercises 10%
1. Colloquium 1: 40% (or exam)</td></tr>
</table>

<table>
<tr><td></td><td colspan="3">2. Colloquium 2: 40% (or exam)
3. Student paper: 10% (obligatory)
4. Excercises: 10% (obligatory)
Rating by percentage:
50% to 62% – sufficient (2)
63% to 75% – good (3)
76% to 88% – very good (4)
89% to 100% – excellent (5)</td></tr>
<tr><td rowspan="4">Required literature</td><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td>Obrada slika i računalni vid, interna skripta.</td><td></td><td></td></tr>
<tr><td>Ramesh Jain, Rangachar Kasturi, Brian G.Schunck, Machine Vision, McGraw-Hill, 1995.</td><td></td><td></td></tr>
<tr><td>Prezentacije s predavanja</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">1. Linda G. Shapiro, George C. Stockman, Computer Vision, Prentice Hall, 2001.
2. Wesley E.Snyder, Hairong Qi, Machine Vision, Cambridge University Press, 2004.
3. D.A. Forsyth, J. Ponce, Computer Vision A Modern Approach, Prentice Hall, 2003
4. Foley, Computer Graphics: Principles and Practice (second edition in C), Addison-Wesley Publishing Company, 1996.</td></tr>
<tr><td>Quality assurance</td><td colspan="3">Conversation with the students.
Students opinions about the quality of teaching through anonymous polls.
The success of students at exam.
Self-evaluation.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

Subject name	Computational Physics		
ID	PMP170	Study year	3.
Lecturer	izv. prof. dr. sc. Petar Stipanović	Points value (ECTS)	4.0
Associates		Class execution (number of hours in semester)	L: 20, S: 5, E: 20, P: 0
Subject status	Elective	Online percentage	50%

Subject description	
Subject goals	To train students to use mathematical, numerical and conceptual elements needed for utilising computers as virtual scientific laboratories in Physics.
Enrolment requirements	Achieved learning outcomes in General Physics and Information Technologies
Learning outcomes	1. Develop appropriate physical models for a wide range of physical systems, according to the understanding of these systems. 2. Formulate physical problems suitable for computing analysis. 3. Use numerical methods that are applicable in different areas of physics. 4. Develop appropriate programmes for established models in the selected programming language, and use them to selected problems. 5. Critical analysis of the obtained results by using developed programmes in relation to input data and model used. 6. Create appropriate visualised presentation of achieved numerical results. 7. Program external computer elements (sensors, tools, etc.). 8. Critical analysis of the measured characteristics and conditions of use of selected sensors. 9. Develop appropriate software for the realisation of the role of automatic numerical systems.
Syllabus	(8h) Physical models. (8h) Numerical methods in physics. (5h) Example of programing packages. (8h) Simulations. (8h) Visualisation of numerical data. (8h) Developemnt and use of sensors.
Teaching types	[x] Lectures [x] Seminars [x] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [x] Individual assignments [ ] Multimedia [x] Laboratory [ ] Mentoring
Student obligations	Active participation on classes and assignments.

Monitoring student work	Class attendance	1.5	Research	0.5	Practical work	0.5
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam			
	Written exam		Project	1		

Assessment and evaluation of student work	Preparation, project and seminar work and presentation on the exam. The final grade is formed according to the following list: [50,60>% = sufficient (2) [60,75>% = good (3) [75,90>% = very good (4) [90,100]% = excellent (5)

Required literature	Title	Number of copies available	Availability on other medium
	[1] Landau, Paez, Bordeianu, Computational Physics: Problem Solving with Computers, Viley, 2007		yes
	[2] Numerical Recipes in C and FORTRAN, The Art of Scientific Computing, Press, Teukolsky, Vetterling and Flannery, Cambridge University Press, 1993		yes

Supplementary literature	[3] Presentations, scripta and examples, M. Dželalija / P. Stipanović
Quality assurance	– Students using web applications can send anonymous comments regarding lectures. – Statistics of test results. – Students' evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

Subject name	Distributed systems					
ID	PMIC50	Study year	2.			
Lecturer	prof. dr. sc. Marko Rosić Dino Nejašmić, pred.	Points value (ECTS)	5.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			30	0	30	0
Subject status	Elective	Online percentage	0%			

Subject description						
Subject goals	Acquiring fundamental knowledge about distributed computing and related systems. Mastery of fundamental principles related to the application, validation and modelling of distributed systems.					
Enrolment requirements	None					
Learning outcomes	1. Enumerate the characteristics, advantages and shortcoming of distributed systems 2. Comprehend the software particularities of distributed systems 3. Understand various communication algorithms for distributed systems 4. Understand logical, vector and matrix clocks, along with the motivation behind them 5. Enumerate and comprehend ways for sharing resources and achieving mutual exclusion using various algorithms in a distributed system 6. Describe the peer-to-peer model					
Syllabus	Lecture on Introduction to distributed systems (2h), definition of distributed systems, advantages and shortcomings of distributed systems (2h), characteristics of distributed systems (2h), resource sharing (2h), hardware settings of distributed systems (3h), operating systems in distributed systems (3h), middleware programs (2h), communication in distributed systems (4h), logical, vector and matrix clocks (4h), mutual exclusion (2h), client-server model (2h), Peer-to-peer networks (2h). Laboratory exercises accompany the lecture topics with the same number of work hours.					
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐			
Student obligations	Lecture and laboratory exercises attendance in accordance with the regulations on studying. The implementation of given laboratory exercises					
Monitoring student work	Class attendance	0.5	Research		Practical work	1.5
	Experimental work		Paper			

	Essay		Seminar paper			
	Colloquiums		Oral exam	1		
	Written exam	2	Project			
Assessment and evaluation of student work	Class attendance (10%). Written/oral exam (by choice) (90%)					
Required literature	Title				Number of copies available	Availability on other medium
	M. Van Steen, A. Tannebaum, Distributed Systems: Principles and Paradigms, Prentice Hall					
Supplementary literature	R. Orfali, D. Harkley, J. Edwards: The Essential Distributed Object Survival Guide, John Wiley					
Quality assurance	Student consultations, anonymous student survey, exam success, self-analysis					
Other (in the opinion of the proponent)						

Subject name	Development and optimization analytical chemical methods		
ID	PPC221	Study year	1.
Lecturer	doc. dr. sc. Ivana Mitar	Points value (ECTS)	2.0
Associates		Class execution (number of hours in semester)	L: 0, S: 0, E: 30, P: 0
Subject status	Elective	Online percentage	40%

Subject description	
Subject goals	Acquire, understand, and apply basic theoretical knowledge of analytical chemistry using classical qualitative and quantitative methods of physicochemical analysis and instrumental methods for solving the problematic task of investigation.
Enrolment requirements	
Learning outcomes	The student is enabled to: 1.distinguish between quantitative and qualitative methods of analysis, 2.participate in the selection of the appropriate method of analysis according to the nature of the samples and the parameters of the investigation, 3.determine an appropriate method to solve a problem, and 4.perform the experimental part of the investigation independently and participate in the interpretation of the results of the analysis.
Syllabus	The student chooses one of the problematic research tasks offered within the framework of analytical or instrumental methods of analysis. The task may be part of an ongoing scientific study or the development of analytical methods about which the student already has knowledge or experience, as an entry into a scientific thesis or dissertation. Under the supervision of the mentor, the student independently researches a literature review, sampling, method establishment, sample preparation and measurement, and interpretation of results. Upon completion of the experimental work, the student is required to write a detailed report on the experiment provided.
Teaching types	☐ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☑ Laboratory ☑ Mentoring ☐ ☐ ☐ ☐
Student obligations	Students are required to participate in the teaching process actively. These will be recorded and evaluated when making the final grade

Monitoring student work						
	Class attendance		Research	0.5	Practical work	
	Experimental work	1.0	Paper			

	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	Practical work will be evaluated upon completion of the experimental section based on the student's dedication, effort, and independence from reviewing the literature to describing the experiment and results in a written report. The final grade will be based on the grade of the practical part, the written report, and/or oral presentation.		
Required literature	Title	Number of copies available	Availability on other medium
	D. C. Harris, Quantitative Chemical Analysis, W. H. Freeman and Company, 41 Madison Avenue New York, NY, 2016.		
	R. Kellner, J. M. Mermet, M. Otto, M. Valcarcel and H. M. Widmer, Analytical Chemistry (A Modern Approach to Analytical Science, Second Edition), Wiley-VCHVerlag Gmbh & Co. KGaA, Weinheim, 2004.		
	B. M. Tissue, Basic of Analytical Chemistry and Chemical Equilibria, John Wiley & Sons, Inc., Hoboken, New Jersey, NY, 2013.		
	D.A. Skoog, D.M. West, F.J. Holler, Osnove analitičke kemije, Školska knjiga Zagreb, 1999.		
Supplementary literature	On-line databases		
Quality assurance	The monitoring of the quality and success of teaching and the acquisition of knowledge (skills) is monitored at the level of (1) teachers, accepting suggestions from students and colleagues, and (2) faculty, conducting student surveys on the quality of teaching.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="7">Research Project</td></tr>
<tr><td>ID</td><td>PMP134</td><td>Study year</td><td colspan="5">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Marko Kovač</td><td>Points value (ECTS)</td><td colspan="5">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td colspan="2">P</td></tr>
<tr><td>0</td><td>30</td><td>0</td><td colspan="2">0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="5">0%</td></tr>
<tr><td colspan="8">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="7"></td></tr>
<tr><td>Enrolment requirements</td><td colspan="7"></td></tr>
<tr><td>Learning outcomes</td><td colspan="7"></td></tr>
<tr><td>Teaching types</td><td>☐ Lectures
☐ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td colspan="5">☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="7"></td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td colspan="2"></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="7"></td></tr>
<tr><td rowspan="2">Required literature</td><td>Title</td><td colspan="2">Number of copies available</td><td colspan="4">Availability on other medium</td></tr>
<tr><td colspan="7">–</td></tr>
<tr><td>Supplementary literature</td><td colspan="7"></td></tr>
<tr><td>Quality assurance</td><td colspan="7"></td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="7"></td></tr>
</table>

Subject name	Symmetries in Physics		
ID	PMP274	Study year	1.
Lecturer	doc. dr. sc. Toni Šćulac prof. dr. sc. Ilja Doršner	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 30, P: 0
Subject status	Elective	Online percentage	5%
Subject description			
Subject goals	The course objective is to introduce students to the methods of group theory in order to describe and study symmetries of physical systems.		
Enrolment requirements	None.		
Learning outcomes	Upon succesful completion of the course a student will be able to: 1. define basic concepts of group theory; 2. name the most common finite and continous groups; 3. implement the tools of group theory to decompose reducible representations of finite groups into irreducible ones; 4. find direct product of representations of Lie groups; 5. explain the connection between permutation groups and representations of unitary groups; 6. describe Lorentz group and its representations.		
Syllabus	1. Symmetries of physical systems, laws of conservation, classification of states. Group theory basics. Group axioms, generators and defining relations, Cayley's tables, subgroups, Lagrange's theorem. 2. Normal subgroups, quotient-groups. Equivalence relations, conjugation classes. Group representations. Dihedral group. 3. Group morphisms. Direct sum and direct product, semidirect group product. Projection operators. Schur's lemma. Representation operations. 4. Characters of representations. Representations of direct group product. Permutation group - cycles, transpositions, and conjugation classes. Permutation group representations. 5. Permutation group algebra. Quantum mechanics examples: n-electron systems. Building up of antisymmetric wave functions out of the spacial and spin wave functions. 6. Young tableaux. 7. Continous groups and associated representations. Lie groups, continuity and analyticity of structure functions. 8. Examples of Lie groups in physics. Properties of Lie algebras - SO(n) and SU(n). 9. Lie group representations and Lie algebras, structure constants. Ireducibile representations of Lie algebra of group of rotations. Canonical basis. Casimir operator. 10. Direct product of representations of Lie group - operators, matrice, and generators. Decomposition of direct product into ireducibie representations for SU(2) group. Clebsch-Gordan coefficients.		

<table>
<tr><td></td><td colspan="6">11. Weight diagrams. (Selection rules. Ireducibile tensor operators, Wigner-Eckart theorem.) Unitary group in particle physics. Isospin, SU(2) group. Hypercharge, SU(3).
12. Representations of unitary groups, connection to permutation group, Young tableaux.
13. Lorentz group and its representations. Homogenous and inhomogenous Lorentz transformations. Properties and ireducibile representations of Lorentz and Poincaré groups. Connection to classical and quantum fields.</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Lecture attendance >70%;
Excercises attendance >70%.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td>Independent work</td><td>2.7</td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td>0.2</td><td>Oral exam</td><td>1</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>0.1</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Two tests (midterm exams).
Final exam.</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">H. F. Jones, Groups, Representations and Physics, 2 nd edition, IOP Publishing, 1998</td><td></td><td></td></tr>
<tr><td colspan="4">J. F. Cornwell, Group Theory in Physics, An Introduction, Academic Press, 1997</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">W. Greiner, B. Müller, Quantum Mechanics - Symmetries, Second Edition,
Springer Verlag, 1994

M. Hamermesh, Group Theory and Its Application to Physical Problems, Dover,
1989</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Evaluation of examination results and the course evaluation via anonymous student evaluation at the end of the course. Anonymous evaluation will be conducted following the rules of University of Split.</td></tr>
<tr><td>Other (in the opinion of the</td><td colspan="6"></td></tr>
</table>

proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Complexity of algorithms</td></tr>
<tr><td>ID</td><td>PMM920</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Jurica Perić</td><td>Points value (ECTS)</td><td>6.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 30, S: 0, E: 30, P: 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>40%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Students will acquire knowledge in advanced algorithmic concepts. They will become familiar with designing efficient algorithms and precise analysis of their complexity.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3"></td></tr>
<tr><td>Learning outcomes</td><td colspan="3">The student is able to:
– apply studied material for the development of new algorithms and calculate complexity of these algorithms
– analyze each algorithm and analyze its basic properties (input, output, efficiency, ...)
– argue the importance of sorting algorithms, reproduce and compare sorting algorithms
– argue advantages and disadvantages of greedy algorithms, support claims on solving optimization problems (minimum spanning tree, ...)
– distinguish which method of constructing algorithms should be used for solving particular problems, compare the chosen method with other methods</td></tr>
<tr><td>Syllabus</td><td colspan="3">Introduction. Algorithms, basic properties, complexity. – 2 hours
Asymptotic behavior of functions. – 2 hours
Recursive algorithms. – 4 hours
Fast matrix multiplication, algorithms for multiplication and division, quicksort. – 4 hours
Greedy algorithm. – 2 hours
Algorithms on graphs. – 2 hours
Dijkstra, Prim, Kruskal algorithms. – 4 hours
Minimum spanning tree, graph search, cycles – 6 hours
Dynamic programming – 4 hours</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Attendance at 70% of lectures and 70% of exercises.</td></tr>
</table>

Monitoring student work	Class attendance	1	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	1.5	Oral exam	2.5		
	Written exam	1	Project			
Assessment and evaluation of student work	The exam is taken in written and oral form. Written exam is preliminary part of the exam and requirement for the oral exam is to pass a written exam. The written form of the exam can be taken partially, during class, where curriculum provided. Activity in class, solving homework, colloquium, written and oral examination are the elements from which form the final grade is formed.					
Required literature	Title	Number of copies available	Availability on other medium			
	T. H. Cormen, C. E. Leiserson, R. L. Rivest, Introduction to Algorithms, MIT Press, Cambridge, Massachusetts, 1990.					
	D. Knuth, The Art of Computer Programming, Vol. 1, Fundamental Algorithms, Addison-Wesley, Reading, MA, USA, 1997.					
Supplementary literature						
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">Sociology of Education</td></tr>
<tr><td>ID</td><td>PMS108</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>Antonija Bašić, pred.</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The main objectives of the course is to familiarize students with the basic objectives, concepts, development, theoretical, social context, the specifics of educational institutions and the position and relations of participants in them.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">No.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After passing the exam each student should be able to:
1. ...describe and to define what is the subject of sociology of education, including beginnings ant the evolution of the discipline, its main basic terms of, its position and value among other sciences);
2nd ...explain wider social context of the education - values provided, a wide range of social relationships within, its social functions, a question of the social un /equality as a consequence of the education, the importance of the education in the modern and the post-modern society; to explain especially the processes that affect process of the education, eventually, the final success and competences of students; as well as specific internal dynamics, its characteristics, problems and deviations of the system itself, etc.);
3rd ... identify the three main sociological (theoretical) perspectives concerning the education-training (basic settings, advantages / disadvantages);
4th ...identify the impact of outer social and technological changes on the development of the education, also concerning education in correlation to the other social phenomena (democratization, multiculturalism, globalization, ecology, technology);
5th ...understand the importance of the role of educators / teachers in today’s society (the characteristics of their profession);
6th ...demonstrate the presentation of educational content of the course.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Introduction to Sociology of Education (2 hours)</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">2. Analysis and explanation of basic concepts (2 hours)
3. Introduction to the historical development of Sociology of Education – the formation, development, scope and tasks; relationship to other sciences (4 hours)
4. Theoretical perspectives of Sociology of education and education□functionalism, conflict theory perspective, interactionism (4 hours)
5. Social inequalities and educational opportunities (2 hours)
6. Changes in the structure and role of the family and education (2 hours)
7. Education and social change – social values; – Socialization and deviant phenomena; Sociology of the profession educator and teacher profession (2 hours)
8. The social context of education (4 hours)
9. The Sociology of the profession teacher and educater (2 hours)
10.The institutional system of education in Croatia (2 hours)
11. Ecology and education (2 hours)
12.New trends (2 hours)</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Class attendance , seminar paper, active participation.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>1</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td>2</td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Class attendance 10%
Preliminary exam 70%
Seminar paper 15%
Activity 5%</td></tr>
<tr><td>Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
</table>

	Cifrić, I. (1990). Ogledi iz sociologije obrazovanja. Zagreb: Školske novine (prva tri poglavlja).		
	Haralambos, M., Holbron, M. (2002).Sociologija: Teme i perspektive. (str. 773-882). Zagreb: Golden marketing.		
	Pilić, Š. (2008.), /ur./, Obrazovanje u kontekstu tranzicije. Split: HPKZ, str. 45-57; 59-66; 129-145; 149-162; 165-174; 239-244.		
	Vujević, M. (1991). Uvod u sociologiju obrazovanja. Zagreb: Informator. str. 4-5; 21-48.		
Supplementary literature	Bognar, B. Škola na prijelazu iz industrijskog u postindustrijsko društvo. Metodički ogledi 10(2): str. 9-24 Farnell, T (2009) Jamči li besplatno obrazovanje i jednak pristup obrazovanju. Revija za socijalnu politiku (god.16 br.2) Piršl, Temeljni pojmovi odgoja, http://209.132/search?q=cache:wtj7xGc4SUIJ.www.ffpu.hr/fileadmin/Documenti/Odgoj_02.ppt+odgoj+definicija&cd=3&hl=en&ct=clnk, 29.1.1020. Ross, A. (2009), Educational Policies that Address Social Inequality: Overall Report. Dostupno na: http://www.epasi.eu		
Quality assurance	• 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 (in the opinion of the proponent)	No.		

Subject name	Sociology of science		
ID	PMS111	Study year	3.
Lecturer	Antonija Bašić, pred.	Points value (ECTS)	2.0
Associates		Class execution (number of hours in semester)	L: 15, S: 15, E: 0, P: 0
Subject status	Elective	Online percentage	0%
Subject description			
Subject goals	1. To present the content of the course in Sociology of science 2. To explain the occurrence and development of Sociology of science 3. To explain wider social context of science and the function of it in society, as well as its place in social structure 4. To critically and creatively analyse science-society relationship, as well as functions of science 5. To notice the impact of science on development of society, and vice versa, i.e. how society influences development of science 6. To describe basic features of social structure of science (scientist, scientific work, relationships and groups in science, scientific institutions and social constructs) 7. To notice and describe connection between sociology of science and other culture components and forms of cognition 8. To critically think about internal and cognitive approaches to science 9. To notice the impact of social and scientific factors interaction in a certain historical period 10. To critically and creatively think about the idea of science and social circumstances		
Enrolment requirements	None.		
Learning outcomes	After passing the exam successfully, students will be able to: 1. explain the content of the course in Sociology of science and basic duties of Sociology of science 2. explain occurrence and development of Sociology of science as a complex result of interaction of economic, political, moral and practical problems of scientific cognition, as well as the impact of science on those 3. explain social functions of science and their place in social structure 4. critically and creatively think, to stimulate interest, motivation and discussion on different impacts of society on science, and impacts of		

	science on society 5. construct a systematic theoretical knowledge about the impacts of society on science, and impacts of science on society 6. explain how social structure of science contributes to, directs (or blocks) development of science 7. understand the purpose of culture within various forms of cognition as a wide research area of Sociology of science 8. explain why internal or cognitive approach to science, where social circumstances are incidental, is not sufficient 9. engage in social researches of science 10. explain the significance of society-science relationship as a cultural tradition				
Syllabus	1. Introductory lecture: Where does science go? Introduction of the programme / giving out the topics for seminar papers 2. The concept and the object of Sociology of science 3. The occurrence and the development of Sociology of science (I) 4. The occurrence and the development of Sociology of science (II) 5. Basic social functions of science 6. Science and other social subsystems 7. Statistic researches on science 8. Social structure of science (the position of a scientist) 9. Social structure of science (scientific work) 10. Social structure of science (relationships and groups in science) I 11. Social structure of science (relationships and groups in science) II 12. Scientific communities and institutions 13. Scientific constructs 14. Impact of different elements of science structure on development of society 15. Impact of scientists in society and impact of society structure on development of science				
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring			☐ ☐ ☐ ☐
Student obligations	Class attendance				
Monitoring student work	Class attendance		Research		Practical work

	Experimental work		Paper			
	Essay		Seminar paper	1		
	Colloquiums	1	Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	Class attendance, class participation, test results, seminar paper results, exam results (if students take the exam).		
Required literature	Title	Number of copies available	Availability on other medium
	.Bucchi, M. (2004). Science in Society. An introduction to Social Studies of Science, London: Routledge (prvo poglavlje od str. 7-23 i sedmo poglavlje od str. 107-123).		
	Ben, D. (1986). Uloga znanstvenika u društvu, Zagreb: Školska knjiga. (uvod, predgovor, prvo i drugo poglavlje od str. 5-52 i deveto zaključno poglavlje sa dodatkom od str. 208-240).		
	Bjelajac, S. (2003). Znanost i društvo, Split: Skripta za studente fizike-informatike, matematike-fizike, fizike-tehničke kulture i informatike-tehničke kulture. (1-202)		
Supplementary literature	1. Habermas, J. (1986). Tehnika i znanost kao ideologija. Zagreb: Školska knjiga. (53-87). 2. Hagstrom, W. (1974). Competition in science, The American Journal of Sociology 39 (1): 1-18. 3. Horgan, J. (2001). Kraj znanosti, Zagreb: Jesenski i Turk. (49-68) 4. Matić, D. (1999). Internalizam racionalnih metodologija i eksterno-socijalna povijest znanosti: argumenti u prilog sociologije znanstvenog znanja. Revija za sociologiju 30 (1-2): 81-98. 5. Matić, D. (2001). Ratovi znanosti: pogled unatrag, Zagreb: Naklada Jesenski i Turk. 6. Milić, V. (1977). Nastajanje sociologije nauke, Sociologija 19 (1): 5-67. 7. Milić, V. (1986). Sociologija saznanja, Sarajevo: Veselin Masleša. Društvene funkcije ideja i znanja. (487-544). 8. Milić, V. (1995). Sociologija nauke: Razvoj, stanje, problemi, Novi Sad: Odsek za filozofiju i sociologiju Filozofskog fakulteta u Novom Sadu; Veternik: LDI. (143-228). 9. Needham, J. (1984). Kineska znanost i Zapad: velika titracija, Zagreb: Školska knjiga. (17-55). 10. Polšek, D. (ur.) (1998). Vidljiva i nevidljiva akademija. Mogućnosti društvene		

	procjene znanosti u Hrvatskoj, Zagreb: Institut društvenih znanosti. 133 Preddiplomski sveučilišni studij Fizika 11. Popović, D. (2012). Žene u nauci: od Arhimeda do Anštajna, Beograd: Službeni glasnik. 12. Popović, M. (1988). Problemi društvene strukture. Beograd: Naučna knjiga. (Priroda socijalnog determinizma i njegove teorijske pretpostavke, Društvena djelatnost i njene sociološke karakteristike, Društveni odnosi i njihova sociološka obilježja, Društvene grupe). 13. Prpić, K. (1996). Produktivnost istaknutih znanstvenika: znanstvena vrsnost i socio-kognitivni kontekst, Revija za sociologiju 27(1-2): 37-52. 14. Prpić, K. (1997). Profesionalna etika znanstvenika, Zagreb: Institut za društvena istraživanja. 15. Prpić, K. (2005). Elite znanja u društvu (ne)znanja, Zagreb: Institut za društvena istraživanja. (185-321). 16. Prpić, K. (2008). Onkraj mitova o prirodnim i društvenim znanostima, Zagreb: Institut za društvena istraživanja. (9-80, 163-189) 17. Sal Restivo. (1994). Science, Society, and Values: toward a sociology of objectivity, London AND Toronto: Associated University Presses. (prvo poglavlje). (PDF) 18. Skledar, N. Kregar, J. (2003). Znanost o društvu, Osnovni pojmovi i razvoj, Zaprešić: Visoka škola. (26-48). 19. Škorić, M. (2010). Sociologija nauke: mertonovski i konstruktivistički programi, Sremski Karlovci, Novi Sad: izdavačka knjižarnica Zorana Stojanovića. (142- 196). 20. Ule, A. (1996). Znanost i realizam, Zagreb: Hrvatsko filozofsko društvo.
Quality assurance	Office hours, discussion, active participation, class and teacher evaluation.
Other (in the opinion of the proponent)	No.

<table>
<tr><td>Subject name</td><td colspan="6">Special Relativity</td></tr>
<tr><td>ID</td><td>PMP401</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Toni Šćulac</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Understanding and explaining basic concepts from the theory of special relativity and classical field mechanics.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">General physics I and II, Electrodynamics I and II.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students are expected to:
1. Understand basic concepts of the theory of special relativity.
2. Learn the calculus with four-vectors and tensors.
3. Understand basics of classical and relativistic field theory.
4. Learn Lagrangian of the free particle, free field and electromagnetic theory.
5. Understand basics of group theory.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Classical mechanics limits (2+1)
2. Einstein-Lorentz transformations (2+1)
3. Relativistic velocity addition (2+1)
4. Four-velocity and four-momentum (2+1)
5. Four-acceleration and four-force (2+1)
6. Reletivistic field theory (2+1)
7. Particles and fields (2+1)
8. Interim exam
9. Relativistic Lorentz law (2+1)
10. Relativistic formulation of Maxwell's equations (2+1)
11. Maxwell's equations from the action principle (2+1)
12. Energy-momentum tensor (2+1)
13. Introduction to group theory (2+1)
14. The Lorentz group (2+1)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="2">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td colspan="3">☐
☐
☐
☐</td></tr>
</table>

Student obligations	Attend at least 70% of lectures and 70% of exercises.					
Monitoring student work	Class attendance	2	Research		Practical work	1
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	0.5	Oral exam	0.5		
	Written exam		Project			
Assessment and evaluation of student work	Two interim exams and a final exam.					
Required literature	Title	Number of copies available	Availability on other medium			
	L. Susskind, A. Friedman, Special Relativity and Classical Field Theory, Penguin books, 2018.	1				
Supplementary literature	[1] V. A. Ugarov. Special Theory of Relativity, MIR 1979. [2] W. Rindler: Relativity, Oxford, 2006.					
Quality assurance	Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">Statistical Physics</td></tr>
<tr><td>ID</td><td>PMP114</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Larisa Zoranić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">5%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Introducing students to the basic properties and description of many-particle systems through the concepts of thermodynamics and statistical physics. A qualitative understanding of the experimentally observed phenomena of microscopic physical models and the ability to quantitatively describe and solve problems using the appropriate mathematical formalism are expected.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Passed courses in General Physics I, II and Mathematics and completed courses in General Physics III and IV and Classical Mechanics</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After successfully completing the course, the student will be able to:
1. Explain the foundations of statistical physics (Brownian motion, multiparticle systems, thermalization, postulate of equal probabilities, distribution functions and probability functions).
2. Derive the Boltzmann distribution, discuss the properties of this distribution, and apply it to interpret the equipartition theorem.
3. Formulate ensemble theory.
4. Describe macroscopic systems within the framework of microcanonical and canonical ensembles and derive thermodynamic quantities.
5. Compare classical and quantum statistical description and discuss the limits of their applicability.
6. Derive and apply Fermi-Dirac and Bose-Einstein distributions, discuss conditions of applicability and behavior in classical limes.
7. Identify and describe the statistical nature of concepts and laws in thermodynamics such as entropy, temperature, chemical potential.
8. Compare the classical and quantum description of an ideal gas and a linear harmonic oscillator.
9. Formulate and apply the blackbody radiation model and the crystal lattice oscillation model.
10. Describe and analyze a highly degenerate Fermi gas.</td></tr>
<tr><td>Syllabus</td><td colspan="6">The timetable worked out according to the weekly plan:
1. Introduction to the course. Thermodynamics. Basic concepts of statistics and probability theory. Statistical behavior of many-particle systems. Maxwell's distribution. Brownian motion. Thermalization.
2. Statistical ensembles. Equilibrium. Density function and probability density. Phase space. Average values of physical quantities and partition function.
3. Microcanonical ensemble. Entropy. System stability conditions.</td></tr>
</table>

	4. Canonic ensemble. The most probable distribution. Boltzmann distribution. Lagrange multipliers. 5. Ideal gas in the canonical ensemble. Comparison of microcanonical and canonical ensemble. Free energy. 6. Explanation of the second law of thermodynamics. Thermal properties of an ideal gas. Law on equipartition of energy. 7. Classic harmonic oscillator. Heat capacity of crystal lattice, ideal gas and two-state model. 8. Fluctuations in statistical physics. 9. Quantization of energy levels. Identical particles. Symmetry of wave functions. 10. Explanation of the third law of thermodynamics. Limits of classical statistics. 11. Quantum harmonic oscillator. 12. Black body radiation: Planck distribution. Rayleigh-Jeans formula, Stefan-Boltzmann law, Wien's law. Photons. 13. Vibration of atoms in crystals: Einstein's and Debye's model. Phonons. 14. Bose-Einstein and Fermi-Dirac distributions. 15. Density function of states. Highly degenerate Fermi systems.
Teaching types	[x] Lectures [ ] Seminars [x] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [x] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring
Student obligations	Prisustvo i zalaganje studenata na satu, rješavanje zadataka na satu i kod kuće. Sudjelovanje u raspravama i diskusijama na satu.

Monitoring student work

Class attendance	2	Research		Practical work	0.5
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums	1.5	Oral exam	2		
Written exam		Project			

Assessment and evaluation of student work	Knowledge is tested by a written and oral exam. Colloquiums are organized during classes. Students who do not pass the written part through the colloquium have 4 additional exam deadlines for passing the written part. The oral exam is taken after the written part.

Required literature

Title	Number of copies available	Availability on other medium
Statistical mechanics-3rd ed. R. K. Pathria, Paul D. Beale, 2011 Elsevier Ltd. Concepts in thermal physics, S. Blundell and K. M. Blundell, 2006 Oxford University Press		

	Statistical physics, Z. Glumac, online script
Supplementary literature	Elementary Statistical Physics, C. Kittel, Dover Publications, 2004 Introduction to Statistical Physics, Kerson Huang, Taylor and Francis, 2001. K. Dill and S. Bromberg, Molecular Driving Forces: Statistical Thermodynamics in Biology, Chemistry, Physics, and Nanoscience, Garland Science; 2nd edition (2010) Feynman, The Feynman Lectures on Physics, (Chapters 39-46), 1963. Scientific articles, lecturesa
Quality assurance	The success of the program is monitored by the quality of knowledge demonstrated in the exams as well as by the assessment of the demonstrated enthusiasm for the subject. External evaluation includes student surveys. Statistics of exam results and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">STATISTICS</td></tr>
<tr><td>ID</td><td>PMM861</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Goran Erceg</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">60%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Ensure that, through selected topics, students acquire knowledge of basic notions, concepts and methods in statistics on the level that is satisfactory for everyday use and for understanding the application of statistics in undergraduate and graduate courses on a life science curriculum. The emphasis is on understanding, appropriate interpretation of data, and on performing a simple statistical analysis. The selected elements of statistical inference form a basis for further comprehension and application of more sophisticated statistical procedures. Students are instructed on how to use one statistical software package ("R", at present).</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Elementary knowledge of calculus and operations with sets.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon successful completion of the course student should be able to
carry out a simple statistical data analysis;
interpret the output of a simple statistical data analysis;
recognize and apply the most frequently used discrete and continuous probability distributions;
estimate different level confidence intervals of a population parameter;
comprehend the idea of statistical testing;
apply a few well-known statistical tests.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Introduction. Descriptive statistics: graphical visualising of data, measuring center, spread, location and shape. (8 hours)
Sample space, classical and statistical definition of probability, probability space. Combinatorial rules. (3 hours)
Conditional probability, independent events and Bayes' rule. (2 hours)
Discrete random variable, probability distribution and (cumulative) distribution function; parameters. Bernoulli, binomial, (hyper)geometric and Poisson random variable. (4 hours)
Continuous random variable, probability density function and (cumulative) distribution function; parameters. Uniform, exponential, chi-square, normal and (Student’s) t-distribution. Central limit theorem. (4 hours)
Two-dimensional random variable. Linear regression and correlation. (3 hours)
Estimation of parameters, confidence intervals. (2 hours)
Statistical testing a hypothesis. Parametric and non-parametric tests. (4 hours)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars</td><td colspan="2">☐ Fieldwork
☑ Individual assignments</td><td colspan="3">☐</td></tr>
</table>

	☑ Exercises ☐ Fully online ☐ Combined online		☐ Multimedia ☐ Laboratory ☐ Mentoring			☐ ☐ ☐
Student obligations	Attending lectures and exercises and taking exams.					
Monitoring student work	Class attendance	1.2	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	1.4	Oral exam	0		
	Written exam	1.4	Project			
Assessment and evaluation of student work	Monitoring and grading students' achievements lasts throughout the semester. Students are assigned homework individually. The exam comprises two partial written tests and a final written test. So as to pass the exam, the summarized score should be at least 50%. Students whose summarized score is less than 50% are admitted to take a "classical" exam in two autumn exam terms. Such an exam consists of a written and an oral part, both equally weighted in the final grade. Passing written test (score ≥50%) is a necessary condition for taking up an oral exam.					

Required literature	Title	Number of copies available	Availability on other medium
	Lecture notes in the form of slides (T. Vučičić)		
	Lecture notes in the form of a book (A. Vukelić, Faculty of Food Technology and Biotechnology)		

Supplementary literature	N. Koceić Bilan, Primijenjena statistika, skripta, PMF Split, 2012. D.S. Moore, G.P. McCabe, B.A. Craig, Introduction to the Practice of Statistics, 6th edition, W. H. Freeman and Co., N.Y., 2009.
Quality assurance	Exam results statistics. Students' quality assessment at the end of the semester carried out by the University authorized committee through anonymous polls.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">STATISTICS IN COMPUTER SCIENCE</td></tr>
<tr><td>ID</td><td>PMM911</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>dr. sc. Ana Perišić</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">An introduction to fundamental statistical concepts and classical methods of statistical analysis; preparing students for independent statistical analysis and the acquisition of basic skills of using statistical software packages.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Introduction to probability and statistics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students will be able to:
conduct descriptive statistical analysis
select and apply statistical models for practical problems in a wide range of areas and assessing their suitability
estimate statistical parameters and calculate the standard error
construct confidence intervals
understand concepts of statistical testing and to perform statistical tests
perform a linear regression analysis and correctly interpret the parameters
demonstrate and prove mathematical statements related to statistical theory covered by this college
use computer tools for creating reports, graphical and tabular presentation of results, and generally to support statistical analysis
critically analyze new literature for data analysis</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures/Exercises (2h/2h):
Introduction. Descriptive statistics: statistical data, classification, frequency distributions, discrete and continuous distributions, tabular and graphical representation.
Descriptive statistics: measures of central tendency, arithmetic mean, geometric mean, harmonic mean, median, mode, quantiles. Measures of dispersion: range, interquartile range, standard deviation. Box-plot, Chebyshev Inequality, moments, standardization, measures of symmetry and peakedness.
Bivariate frequency distribution, contingency table. Marginal distribution. Conditional distribution. Statistical independence.
Random variables, discrete and continuous random variables functions of random variables.
Joint distributions. Conditional distributions. Independance.
Expectation, variance and covariance.Conditional expectation.
Central limit theorem.
Sampling. Population , sample. Population parameter , statistic. Simple random sampling (with/without replacement, finite population, infinite population). Stratified sampling.</td></tr>
</table>

	Parameter estimation. Method of moments. Standard error. Unbiasedness. Maximum likelihood method. Asymptotic distribution of maximum likelihood estimators. Confidence intervals. Testing statistical hypotheses. Statistical hypothesis. Statistical test. Statistical error. Classical statistical hypothesis testing. The Neyman-Pearson paradigm . Significance level. The concept of p-value. One sample statistical tests, two-sample tests. c2-goodness of fit test, the Kolmogorov-Smirnov test,. c2-of homogeneity, c2-for independence, hypothesis testing for paired dana. The Analysis of Variance. One-way ANOVA. Correlation and regression. Correlational analysis. Regression analysis. Parameter estimation. Gauss - Markov theorem. ANOVA-table. Prediction.
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Pohađanje nastave, izrada domaćih zadataka.

Monitoring student work

Class attendance	0.1	Research		Practical work	1
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam	0.4		
Written exam	3.5	Project			

Assessment and evaluation of student work	Attending lectures, writing homework, written and oral exam. During the semester, students have the possibility to partially take written exams through colloquia (twice during the semester). Students who pass both colloquia don't need to take part in the written exam.

Required literature

Title	Number of copies available	Availability on other medium
N. Sarapa, Teorija vjerojatnosti, Školska knjiga, Zagreb, 2002.		
John A. Rice, Mathematatical Statistics and Data Analysis, Second Edition, Duxbury Press, 1996.		da
F. Daly, D. J. Hand, M. C. Jones, A. D. Lunn, K. J. McConway, Elements of Statistics, Addison Wesley, 1995		

Supplementary literature	G. K. Bhattacharyya, R. A. Johnson, Statistical Concepts and Methods, John Wiley & Sons, 1977. Ž. Pauše, Uvod u matematičku statistiku, Školska knjiga, Zagreb, 1993. R.V. Hogg, A.Craig, J.W. McKean, Introduction to Mathematical Statistics, 6th edition, Pearson Prentice Hall D. Freedman, R. Pisani, R. Purves, A. Adhikari, Statistics, 2nd edition, W. W. Norton & Co, 1991. D. J. Savile, G. R. Wood, Statistical Methods. A Geometric Primer, Springer Verlag, 1996. D. Williams, Weighing the Odds, Cambridge University Press, 2001. Priručnici za korištenje R-a (npr. W.N. Venables i D.M. Smith (M.Kumbatović, Kasum D.), Uvod u korištenje R-a)
Quality assurance	Summarizing test results and conducting an anonymous student survey at the end of the course. The survey is conducted according to the rules of the University of Split. .
Other (in the opinion of the proponent)	

Subject name	Stochastic Simulations in Classical and Quantum Physics		
ID	PMP271	Study year	1.
Lecturer	prof. dr. sc. Leandra Vranješ Markić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L S E P 30 0 30 0
Subject status	Compulsory	Online percentage	10%
Subject description			
Subject goals	Deeper understanding of selected topics of classical and quantum physics. Understanding the advantages and limitations of Monte Carlo simulations. Testing and developing simpler simulations. The ability to visualise and critically evaluate obtained results.		
Enrolment requirements	Basic knowledge of statistical and quantum physics, as well as programming.		
Learning outcomes	1. Know several Monte Carlo simulation methods. 2. Be able to independently develop and apply Metropolis algorithm for a given probability distribution. 3. Be able to evaluate the efficiency and validity of the results of a given Monte Carlo algorithm. 4. Understand the advantages and limitations of stochastic simulations of phase transitions. 5. Be able to apply the learned methods to selected problems of classical and quantum many-body physics and to interpret the obtained results. 6. Adapt the program to run on high performance computing (HPC) clusters.		
Syllabus	Basic techniques of stochastic simulations are introduced and applied to different physical systems and models. The exercises on computers follow the following content of the lectures according to the same schedule. DETERMINISTIC RANDOMNESS (1h) Pseudorandom number generators. (1h) Testing for randomness and uniformity. (2h) Simulating random variables. Random walk. (4h) Brownian dynamics. Diffusion and entropy. (2h) Distributions. Percolation. (2h) Radioactive decay. (1h) Distribution transformation methods and rejection methods. (1h) Multidimensional integration using Monte Carlo methods. (2h) Markov chains. Metropolis algorithm. (2h) Estimation of statistical errors. MONTE CARLO SIMULATIONS OF THERMAL SYSTEMS (2h) Ideal gas. Demon algorithm. (2h) Ising model. Periodic boundary conditions.		

	(2h) Simulation on High Performance Computing (HPC) clusters. (3h) Simulation of continuous systems. Classical fluids. QUANTUM MONTE CARLO METHODS (3h) Variational Monte Carlo. Diffusion Monte Carlo.
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Homework during semester. Final project and presentation.

Monitoring student work

Class attendance	2	Research		Practical work	2
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam			
Written exam		Project	2		

Assessment and evaluation of student work	Homework and the final project, in which the student should independently develop the program using the appropriate Monte Carlo method, and presentation are evaluated. For homework and project, the students should write a report in which they answer the questions asked and critically evaluate obtained results.

Required literature

Title	Number of copies available	Availability on other medium
[1] L. Vranješ Markić, P. Stipanović: "Stohastičke simulacije u klasičnoj i kvantnoj fizici", skripta, PMFST, Split, 2016.		yes
[2] Harvey Gould, Jan Tobochnik, and Wolfgang Christian: "An Introduction to Computer Simulation Methods", 3rd revised edition, 2016. URL: https://www.compadre.org		yes

Supplementary literature	[3] R. H. Landau & M. J. Paez: "Computational Problems for Physics", CRC Press, Taylor & Francis, 2018. [4] M. P. Allen & D. Tildesley: "Computer Simulation of Liquids", Clarendon Press, Oxford, 1987. [5] Different web pages.
Quality assurance	Lecturers who teach subjects, which have correlated learning outcomes, collaborate and take care of teaching quality. Discussion with students and analyzing their progress in solving problem and project tasks. Statistics of exam results and evaluation of efficacy in accordance with the learning outcomes.

	Student evaluation by anonymous survey conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">English for Specific Purposes I</td></tr>
<tr><td>ID</td><td>PMS252</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>Ana Mršić Zdilar, pred.</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>0</td><td>30</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">- upoznati studente s osnovnim zakonitostima prevođenja stručnih tekstova iz područja biologije i kemije
- razvijati vještine i tehnike čitanja s razumijevanjem stručnih i znanstvenih tekstova na engleskom jeziku iz područja prirodnih znanosti
- poticati usvajanje stručne terminologije iz područja biologije i kemije
- ponavljati i proširivati gramatičke kategorije engleskog jezika, osobito one karakteristične za stručne tekstove
- razvijati pismene i usmene komunikacijske vještine studenata na engleskom jeziku</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Četverogodišnje srednjoškolsko obrazovanje s engleskim jezikom kao prvim ili drugim stranim jezikom.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Nakon odslušanog i položenog predmeta, student će moći:
- s razumijevanjem pročitati stručni tekst na engleskom jeziku i prevesti ga na hrvatski jezik
- jezično i sadržajno analizirati stručni tekst na engleskom jeziku
- realizirati usmeno izlaganje na engleskom jeziku, odnosno prezentaciju na određenu temu iz struke
- napisati kraći tekst na engleskom jeziku s temom iz područja biologije i kemije
- temeljem stečenih kompetencija u domeni stručnog vokabulara na engleskom jeziku, uspješno pretraživati i koristiti relevantnu stručnu literaturu
- pravilno se služiti različitim gramatičkim kategorijama tipičnim za stručne tekstove (npr. pasivne konstrukcije, neodređene zamjenice, složenice i dr.) .</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Biology-the Study of living Organisms
2. The Characteristics of Living Things
3. The Differences between Plants and Animals
4. The Characteristics of Plants and Animals
5. The Need for Energy-Autotrophs and Heterotrophs
6. Photosynthesis
7. Food Webs, Energy Flow, and Nutrient Cycles
8. Ecology
9. Introduction to Chemistry /Elements, Compounds and Mixtures
10. Solutions and Water
11. Suspensions, Colloidal Suspensions, Emulsions
12. Crystals</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">13. Purification of Water
14. Oxygen/ Hydrogen
15. Atomic Structure I/II</td></tr>
<tr><td>Teaching types</td><td colspan="2">☐ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Nazočnost na nastavi, aktivno sudjelovanje u nastavi, realizacija prezentacije (usmenog izlaganja) na engleskom jeziku na zadanu temu iz struke, polaganje dvaju kolokvija ili ispita</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td>0.5</td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td>1</td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Nazočnost na nastavi, praćenje aktivnosti studenata na nastavi, prezentacija, dva kolokvija, ispit (ako mu student pristupi).</td></tr>
<tr><td rowspan="2">Required literature</td><td>Title</td><td colspan="2">Number of copies available</td><td colspan="3">Availability on other medium</td></tr>
<tr><td colspan="6">–</td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Jovanović, T:: English for Chemistry, Sveučilište u Zagrebu, Zagreb 1989</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6">Nema.</td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">English for Specific Purposes (II)</td></tr>
<tr><td>ID</td><td>PMS253</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>Ana Mršić Zdilar, pred.</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>0</td><td>30</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">– upoznati studente s osnovnim zakonitostima prevođenja stručnih tekstova iz područja biologije i kemije
– razvijati vještine i tehnike čitanja s razumijevanjem stručnih i znanstvenih tekstova na engleskom jeziku iz područja prirodnih znanosti
– poticati usvajanje stručne terminologije iz područja biologije i kemije
– ponavljati i proširivati gramatičke kategorije engleskog jezika, osobito one karakteristične za stručne tekstove
– razvijati pismene i usmene komunikacijske vještine studenata na engleskom jeziku</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Četverogodišnje srednjoškolsko obrazovanje s engleskim jezikom kao prvim ili drugim stranim jezikom</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Nakon odslušanog i položenog predmeta, student će moći:
– s razumijevanjem pročitati stručni tekst na engleskom jeziku i prevesti ga na hrvatski jezik
– jezično i sadržajno analizirati stručni tekst na engleskom jeziku
– realizirati usmeno izlaganje na engleskom jeziku, odnosno prezentaciju na određenu temu iz struke
– napisati kraći tekst na engleskom jeziku s temom iz područja biologije i kemije
– temeljem stečenih kompetencija u domeni stručnog vokabulara na engleskom jeziku, uspješno pretraživati i koristiti relevantnu stručnu literaturu
– pravilno se služiti različitim gramatičkim kategorijama tipičnim za stručne tekstove (npr. pasivne konstrukcije, neodređene zamjenice, složenice i d</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Reproduction
2. The Importance of Sexual Reproduction
3. Species and their Adaptations
4. Adaptations
5. The Evidence for Evolution
6. Natural Selection
7. The Diversity of Life
8. Man and the Ecosystem
9. Metals and Non-metals
10. The Periodic Table
11. Symbols, formulas and equations
12. Ionization I</td></tr>
</table>

	13. Ionization II 14. Acids 15. Bases
Teaching types	☐ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Nazočnost na nastavi, aktivno sudjelovanje u nastavi, realizacija prezentacije (usmenog izlaganja) na engleskom jeziku na zadanu temu iz struke, polaganje dvaju kolokvija ili ispita.

Monitoring student work						
	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper	0.5		
	Essay		Seminar paper			
	Colloquiums	1	Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	Nazočnost na nastavi, praćenje aktivnosti studenata na nastavi, prezentacija, dva kolokvija, ispit (ako mu student pristupi)

Required literature	Title	Number of copies available	Availability on other medium
	–		

Supplementary literature	Jovanović, T: English for Chemistry, Sveučilište u Zagrebu, Zagreb 1989
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	Nema

<table>
<tr><td>Subject name</td><td colspan="6">Light and Photosynthesis in the Sea</td></tr>
<tr><td>ID</td><td>PMP26G</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Žarko Kovač</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>20</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">- acquiring basic knowledge about marine optics and bio-optical models of photosynthesis
- to provide knowledge about the use of partial differential equations and the theory of dynamic systems when describing bio-optical processes in the sea
- acquire knowledge about primary production models from local to global scale
- get acquainted with the basics of the critical depth theory, critical light theroy and the critical turbulence theory
- provide basic knowledge about the coupling of physical processes and photosynthesis in the sea</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">- Mathematical methods of physics II
- Differential equations
- Programming</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Understand inherent and apparent optical properties.
2. Know the basics of radiative transfer theory.
3. Know how to calculate the intensity of the underwater light field based on knowledge of solar radiation.
4. Understand the relationship between the carbon assimilation rate in photosynthesis and light intensity.
5. Understand the vertical structure of primary production and chlorophyll in the sea.
6. Know the basics of the critical depth theory, critical light theory and critical turbulence theory.
7. Basic knowledge on spectral effects in photosynthesis.
8. Master the mathematical apparatus used in modern oceanography to describe the connection between physical and biological processes.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Inherent and apparent optical properties of ocean water (2 hours of lectures)
2. Radiative transfer theory (2 hours of lectures)
3. Solar radiation (2 hours of lectures)
4. Underwater light field (2 hours of lectures)
5. Light saturation function (2 hours of lectures)
6. Primary production profile (4 hours of lectures)
7. Watercolumn produciton (4 hours of lectures)
8. Vertical dynamics of chlorophyll in the ocean (4 hours of lectures)
9. Critical depth theory (2 hours of lectures)
10. Critical light theory (2 hours of lectures)</td></tr>
</table>

	11. Critical turbulence theory (2 hours of lectures) 12. Spectral effects (2 hours of lectures)

Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring	☐ ☐ ☐ ☐
Student obligations	Attend at least 70% of lectures and 70% of exercises.		

Monitoring student work	Class attendance	1	Research		Practical work	1
	Experimental work		Paper		Domaće zadaće	1
	Essay		Seminar paper			
	Colloquiums		Oral exam	1		
	Written exam		Project			

Assessment and evaluation of student work	During the first 7 weeks of classes, students receive 5 homework assignments from the first 5 teaching units. These assignments are handed in at the end of the 8th week of classes. During the next 7 weeks of classes, students receive 5 new homework assignments from the following 5 teaching units. These assignments are handed in at the end of the 15th week of classes. Students who submit assignments on time and achieve more than 50% of possible points are exempt from writing the written part of the exam. Students who do not hand in assignments or obtain less than 50% of the possible points must take a written exam. In the first 7 weeks of classes, the teacher holds seminars and solves more complex problems analytically and numerically together with the students. In the 8th week of classes, students choose a model that they analyze analytically, and implement a numerical version of the model and conduct simulations. Students present the obtained simulations at the end of the semester. The final grade is formed on the basis of homework/exams (1/3 of the grade), simulations (1/3 of the grade) and answers to the oral exam (1/3 of the grade).

Required literature	Title	Number of copies available	Availability on other medium
	John T. O. Kirk Light and photosynthesis in aquatic ecosystems Cambridge Universiy Press, 2011.	2	yes
	Curtis D. Mobley The oceanic optics book Creative Commons Licence	0	yes
	Mark Kot Elements of Mathematical Ecology Cambridge Universiy Press, 2001.	2	yes

Supplementary literature	Internal script and scientific papers.

Quality assurance	Discussion with students and analysis of their progress in solving problems and tasks. Statistics of exam results and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="7">Text and Graphical Programs for Physicists</td></tr>
<tr><td>ID</td><td>PMP071</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Martina Požar</td><td>Points value (ECTS)</td><td colspan="4">1.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>0</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Ability to use Gnuplot.
Ability to use LaTeX.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After successfully mastering the course, students will be able to
use the programs as follows:
1) Gnuplot
– draw 2D and 3D graphs,
– fit functions on numerical data,
– write scripts that generate drawings;
2) LaTeX
– make presentations,
– write a seminar and laboratory report,
– edit the content (text, images, formulas, tables...) for
publication in the form of a scientific article, book...</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Gnuplot (10h)
(3h) Drawing 2D graphs.
(2h) Fitting functions to numerical data.
(2h) Schematic representations using geometric figures.
(3h) Drawing 3D graphs.
2. LaTeX (20h)
(3h) Introduction to LaTeX2e. Text input and formatting.
(5h) Writing mathematical formulas (equations).
(2h) LaTeX environments. List. Tables.
(2h) Insert images and draw with TikZ.
(2h) Structuring a document (article, book...).
(2h) Definition of own commands and environments.
(2h) Defining mathematical environments such as theorems.
(2h) Making presentations using the beamer package.</td></tr>
</table>

<table>
<tr><td>Teaching types</td><td>☐ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Attendance and commitment of students in class, making assignments with help and independently in class or at home.</td></tr>
</table>

<table>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>0.7</td><td>Research</td><td></td><td>Practical work</td><td>0.3</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
</table>

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">During the semester, the student's work on the computer is monitored and scored (20% of the final mark) and exams for
LaTeX (50%) and Gnuplot (30%) are written.
The final grade is formed according to the following list:
[50.60>% = sufficient (2)
[60.75>% = good (3)
(75.90>% = very good (4)
[90,100]% = excellent (5)</td></tr>
<tr><td rowspan="3">Required literature</td><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td>[1] Š. Ungar, Not so short introduction to TeX with emphasis on LaTeX2ε, University of Osijek, Department of Mathematics, Osijek 2002. (web)</td><td></td><td></td></tr>
<tr><td>[2] Instructions that come with the Gnuplot software package.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">[1] Thomas Williams, Colin Kelley: An Interactive Plotting Program
gnuplot 5.0, URL: http://www.gnuplot.info/docs_5.0/gnuplot.pdf,
siječanj 2016.
[2] ShareLaTeX Documentation, URL:
https://www.sharelatex.com/learn.</td></tr>
<tr><td>Quality assurance</td><td colspan="3">1. Teachers, who teach other similar subjects, cooperate and jointly take care of the quality of teaching.
2. Students can send anonymous comments related to the teaching method via the web application.</td></tr>
</table>

	3. Test result statistics. 4. Student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.
Other (in the opinion of the proponent)	

Subject name	Design Theory		
ID	PMM614	Study year	2.
Lecturer	doc. dr. sc. Aljoša Šubašić	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 45, S: 0, E: 0, P: 0
Subject status	Elective	Online percentage	10%
Subject description			
Subject goals	To introduce students to the basic definitions, terms, procedures, and theorems of design theory To make a connection between different combinatorial structures, and to connect designs with graphs, difference sets, Latin squares To introduce basic applications of combinatorial designs in different areas such as board game design and similar.		
Enrolment requirements	Basic knowledge of linear algebra.		
Learning outcomes	After taking and passing this course students are able to Differenciate all notions and properties of designs, and can apply that knowledge towards solving problems; Analyse different combinatorial structures and describe their properties, and also explain connections between those structures; Mathematicly prove the basis for their procedures and formulas they use that are within this course; Make a model of their own board game constructed by a certain design		
Syllabus	Basic notions of design theory. 6 hours Isomorphisms and automorphisms, constructions of new designs, Fisher's inequality. 3 hours Symmetric designs, derived and residual designs, Bruck-Ryser-Chowla. 3 hours Difference sets. 3 hours Hadamards matrices and designs. 3 hours Latin squares. 3 hours Steiner triple systems. 3 hours Flag-transitive designs, primitive i imprimitive designs. 6 hours Subdesigns and quotient designs. 3 hours t-designs. 3 hours Design applications. 3 hours		
Teaching types	☑ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐

<table>
<tr><td>Student obligations</td><td colspan="6">Class attendance and one seminar paper.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>2</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>2</td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Seminar paper and the final oral exam.</td></tr>
<tr><td rowspan="2">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Douglas R. Stinson: Combinatorial designs. Constructions and analysis</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Beth, Jungnickel, Lenz: Design Theory, Volume 1</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="3">Graph theory</td></tr>
<tr><td>ID</td><td>PMM806</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Tanja Vojković</td><td>Points value (ECTS)</td><td>5.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L S E P
30 0 30 0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>30%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">The aim of the course is to introduce students to the basic topics and methods of graph theory.
Students will learn to understand properties of graphs, and their importance in applications..</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Entry competences: Students should be familiar with basic concepts of linear algebra.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Students will be able to :
correctly formulate theorems and definitions of important concepts,
illustrate the concepts and conclusions with adequate examples,
construct mathematical proofs,
model and solve problems using graph theory,
apply the obtained knowledge and skills to investigate and solve a variety of graph theory problems,
clearly and unambiguously communicate their arguments and conclusions to both laics and experts
have the learning skills which enable lifelong education in this field</td></tr>
<tr><td>Syllabus</td><td colspan="3">Introduction. Graphs and drawings of graphs. Basic concepts of graph theory. Examples of different graph types. (3)
Bipartite graphs. Graph isomorphisms. (2)
Connectivity in graphs, walks and paths. (3)
Euler and Hamiltonian graphs. (3)
Trees, characterization and properties, counting trees. (3)
Graph colorings, vertex and edge colorings, chromatic number (4)
Planar graphs, Euler's theorem, colorings of planar graphs. (3)
Directed and weighted graphs. (3)
Vertex and edge connectivity. (2)
Pairings in graphs, vertex and edge covers, perfect and maximal matchings. (4)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Class attendance. Students are expected to be present at least 70% of classes.</td></tr>
</table>

Monitoring student work	Class attendance	3	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	1		
	Written exam	1	Project			
Assessment and evaluation of student work	Two partial written exams / one final written exam and final oral exam. There are 2 partial written exams during the semester. Passing the both partial exams or the final written exam allows students to take the oral exam. Successfully passing the oral exam leads to a successful completion of the course.					
Required literature	Title				Number of copies available	Availability on other medium
	A. Golemac, Osnove teorije grafova, skripta, PMF, Split, 2014.					
	D. Veljan, Kombinatorna i diskretna matematika, Algoritam, Zagreb, 2001					
	D. Veljan, Kombinatorika s teorijom grafova, Školska knjiga, Zagreb, 1989.					
Supplementary literature	J. Matoušek, J. Nešetril, Invitation to Discrete Mathematics, Oxford University Press, Oxford, 1998. R.J. Wilson, Introduction to Graph Theory, Longman, Harlow, Essex, 1999.					
Quality assurance	Anonymous student evaluations according to the regulations of the University of Split and summarizing test results.					
Other (in the opinion of the proponent)						

Subject name	Game Theory						
ID		Study year	2.				
Lecturer	prof. dr. sc. Damir Vukičević	Points value (ECTS)	5.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			45	0	0	0	
Subject status	Elective	Online percentage	0%				
Subject description							
Subject goals	Student learns the basics of game theory. He is capable to explain basic concepts of game theory, solve simpler problems in game theory and recognize real-life situations on which game theory can be applied. He can note and comprehend interplay between game theory and economics.						
Enrolment requirements	Prerequisites: introductory mathematical course completed. Required competencies: knowledge of elementary mathematics basic knowledge of integrals and derivatives.						
Learning outcomes	Student is able to: - define basic notions related to dominant strategies, Nash's equilibria, evolutionary and economical models; - analyze different types of Nash's equilibria; - analyze outcomes of simpler games - solve simpler games; - compare different auction types; - analyze axioms of utility function and Nash axioms; - apply game theory on simpler economic models.						
Syllabus	dominant and dominated strategies (2) pure Nash equilibrium, zero-sum games, mixed Nash equilibrium (4) economical models (2) evolutionary models (2) exemplary games (2) finite games and backward induction(2) games of complete and non-complete information (2) repetitive games and moral risk (2) exemplary games (2) auctions (2) utility function (2) negotiation problem (4))						
Teaching types	☑ Lectures ☐ Seminars	☐ Fieldwork ☐ Individual assignments	☐				

	☐ Exercises ☐ Fully online ☐ Combined online		☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐	
Student obligations	Lectures attendance and passing colloquium exams.					
Monitoring student work	Class attendance	1.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	1.5	Oral exam	2		
	Written exam		Project			
Assessment and evaluation of student work	Colloquiums, final (written and oral) exam.					

Required literature	Title	Number of copies available	Availability on other medium
	Open Yale Course on Game Theory. http://oyc.yale.edu/economics/econ-159		
	M. J. Osborne, A. Rubinstein: A Course in Game Theory, MIT Press, 1998		

Supplementary literature	J.H.Conway, On Numbers and Games, Academic Press, 1976 E. Berlekamp, H. Conway, R.Guy,Winning ways for your mathematical plays, AK Peters Ltd, 2001 (Vol 1) E. Berlekamp, H. Conway, R.Guy,Winning ways for your mathematical plays, AK Peters Ltd, 2001 (Vol 2) E. Berlekamp, H. Conway, R.Guy, Winning ways for your mathematical plays, AK Peters Ltd, 2001 (Vol 3) E. Berlekamp, H. Conway, R.Guy,Winning ways for your mathematical plays, AK Peters Ltd, 2001 (Vol 4)
Quality assurance	Statistics of exam results and student’s course evaluation (survey according to rules of the University of Split).
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="4">Relativity</td></tr>
<tr><td>ID</td><td>PMP401</td><td>Study year</td><td colspan="2">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Toni Šćulac</td><td>Points value (ECTS)</td><td colspan="2">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td colspan="2">L | S | E | P</td></tr>
<tr><td colspan="2">30 | 0 | 30 | 0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="2">0%</td></tr>
<tr><td colspan="5">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="4"></td></tr>
<tr><td>Enrolment requirements</td><td colspan="4"></td></tr>
<tr><td>Learning outcomes</td><td colspan="4"></td></tr>
<tr><td>Teaching types</td><td>☐ Lectures
☐ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="2">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="4"></td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>Research</td><td colspan="2">Practical work</td></tr>
<tr><td>Experimental work</td><td>Paper</td><td colspan="2"></td></tr>
<tr><td>Essay</td><td>Seminar paper</td><td colspan="2"></td></tr>
<tr><td>Colloquiums</td><td>Oral exam</td><td colspan="2"></td></tr>
<tr><td>Written exam</td><td>Project</td><td colspan="2"></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="4"></td></tr>
<tr><td rowspan="2">Required literature</td><td>Title</td><td>Number of copies available</td><td colspan="2">Availability on other medium</td></tr>
<tr><td colspan="4">–</td></tr>
<tr><td>Supplementary literature</td><td colspan="4"></td></tr>
<tr><td>Quality assurance</td><td colspan="4"></td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="4"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">Set theory</td></tr>
<tr><td>ID</td><td>PMM112</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Goran Erceg</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Students will:
-gain insight in Set theory necessary for understanding and learning other mathematical concepts
-learn to conduct various set operations and operations with cardinals and ordinals
-learn to compute cardinality of sets given in various ways
- gain a deeper insight in a historical significance of Cantor's "naive" approach to Set theory
-learn the Zermelo-Frankel system of axioms and understand its role in avoiding paradoxes.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon successful completion of this course students will be able to:
- explain and evaluate a historical role of Cantor's naive approach to Set theory
- axiomatically describe Set theory by the Zermelo-Frankel system of axioms
-compute cardinality of sets given in various ways
-apply cardinal and ordinal numbers arithmetic and order between cardinals and ordinals
-apply the Cantor-Bernstein theorem and other theorems on cardinality
-characterize order types of the sets N, Z, Q and R
-define the ordinal number and number class
-apply Transfinite induction
-state various theorems equivalent to Axiom of choice.</td></tr>
<tr><td>Syllabus</td><td colspan="6">- Introduction. Cantor's "naive" approach to Set theory. Paradoxes. (1)
- The Zermelo-Frankel system of axioms .(4)
-Relations and functions. (1)
-Inductive and transitive sets. Peano axioms. The Recursion theorem. (3)
-The Axiom of choice. The function of choice. A family of sets. The product of set family. (1)
-Finite and infinite sets. (2)
-Equipotent sets. Cardinal numbers. The Cantor-Bernstein theorem. (2)
-Countable sets. The product and union of countable sets. (4)
-Uncountable sets. Continuum. The continuum hypothesis. (2)
-A partial order. A total order. Isomorphisms of ordered sets. Order types. (4)
-Characterizations of the ordered sets N, Z, Q and R. (2)</td></tr>
</table>

	–Well-ordered sets. Ordinal numbers. Transfinite induction. The Buralli-Forti paradox. (2) –Number classes. Statement equivalent to the Axiom of choice. (2)					
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations	Attending classes. Students are expected to be present at least 70% of classes.					
Monitoring student work	Class attendance	2	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	2		
	Written exam	2	Project			
Assessment and evaluation of student work	Two partial written exams / one final written exam and final oral exam. There are 2 partial written exams during a semester. Passing both partial exams enables students to take an oral exam. Successfully passing the oral exam leads to successful completion of the course. Final grade is derived as the arithmetic mean of scores in partial exams (or a written exam) and the oral exam. In the case of failure in partial exams or the oral exam students must undergo a written exam before taking oral exam again. Written exam consists of practical and theoretical exercises.					
Required literature	Title				Number of copies available	Availability on other medium
	V. Matijević, Uvod u teoriju skupova, nastavni materijal–skripta					
	P. Papić, Uvod u teoriju skupova, HMD, Zagreb,2000.					
	H.B. Enderton, Elements of Set Theory, Academic Press, New York, 1977P					
Supplementary literature	K. Kuratowski, A. Mostowski, Set Theory, PWN, Warszawa, 1968.					
Quality assurance	Summarizing test results and conducting an anonymous student survey at the end of the course. The survey is conducted according to the rules of the University of Split. u.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="3">Field Training in General Zoology</td></tr>
<tr><td>ID</td><td>PMB014</td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Biljana Apostolska</td><td>Points value (ECTS)</td><td>0.5</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L S E P
15 0 0 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>10%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">To learn how to use the different techniques of the field examinations in zoology in a way to know how to collect, prepare, conservate and make a determination of collected material using the determination keys.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Student will be able to:
1. to make a diary of field training
2. to collect and determinate using the key for determination different groups of collected animals
3. to use different kind of the equipment for the field training
4. to use different kind of technique for collecting the samples</td></tr>
<tr><td>Syllabus</td><td colspan="3">Three whole day excursions on a three different biotopes: 1. freshwater
2. terrestrial
3. sea biotopes
4. laboratory work in preparation, conservation and determination of the collected material</td></tr>
<tr><td>Teaching types</td><td>☐ Lectures
☐ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☑ Fieldwork
☐ Individual assignments
☐ Multimedia
☑ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">To participate in full</td></tr>
<tr><td>Monitoring student work</td><td colspan="3">
<table>
<tr><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
</table>
</td></tr>
<tr><td>Assessment and evaluation</td><td colspan="3"></td></tr>
</table>

of student work	seminar presentation		
Required literature	Title	Number of copies available	Availability on other medium
	Campbell, A. Guide to seashores and shallow seas of Britain and northern Europe.		web
	Philip's, London. Fish, J.D., Fish, S., 2011. A student's guide to the seashore. University Press, Cambridge.		
	Grubišić, F., 1990: Ribe, rakovi i školjke Jadrana. Naprijed, Zagreb		
	Heinzel, H., 1999: Ptice Hrvatske i Europe: sa Sjevernom Afrikom i Srednjim Istokom. Hrvatsko ornitološko društvo, Zagreb.		
	Milišić, N, 2008: Jadranski rakovi deseteronošci. Marjan tisak, Split.		
	Riedl, R. (ed.), 1981: Fauna und Flora der Adria. Verlag Paul Parey, Hamburg, Berlin.		
	Vidaković, J., Bogut, I., Čerba, D., Galir, A., 2007. Priručnik za terensku nastavu 2. – zoologija: beskralježnjaci mora.		
Supplementary literature	Antolović, J., Flajšman, E., Frković, A., Grgurev, M., Grubešić, M., Hamidović, D., Holcer, D., Pavlinić, I., Vuković, M., Tvrtković N., 2006: Crvena knjiga sisavaca Hrvatske. Ministarstvo kulture, Državni zavod za zaštitu prirode, Republika Hrvatska. Arnold, N., Burton, J. A., Ovenden, D., 1978. Field Guide to the Reptiles and Amphibians of Britain and Europe (Collins Field Guide). HarperCollins Publishers, London. Habdija, I. i sur. (2004). Protista-Protozoa i Metazoa-Invertebrata. Funkcionalna građa i praktikum. Meridijani, Samobor. Janev Hutinec, B., Jovanović, O., Šafarek, G., Janković, S., 2013: Žaba, kača, kuščar- vodozemci i gmazovi u Međimurju. Međimurska priroda- Javna ustanova za zaštitu prirode, Međimurje. Ruppert, E.E., R. S. Fox and R. D. Barnes (2004). Invertebrate Zoology. A functional evolutionary approach. Seventh edition, Thomson Brooks/Cole.		
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="7">Thermodynamics</td></tr>
<tr><td>ID</td><td>PMP007</td><td>Study year</td><td colspan="5">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Ante Bilušić</td><td>Points value (ECTS)</td><td colspan="5">9.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>60</td><td>15</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Understanding the concepts and laws of thermodynamics and their application.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Acquired content from mathematical analysis, mechanics, and electricity and magnetism.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Explain the basic concepts of thermodynamics and analyze the effects of temperature changes on bodies.
2. Analyze and apply methods of heat transfer and calculate the amount of heat transferred using specific examples.
3. Introduce and explain specific heat of transformation. Analyze phase transitions, describe the phase diagram, critical points and triple points, and derive the Clausius-Clapeyron equation.
4. Determine the relationship between temperature and the mean kinetic energy of molecules in the kinetic-molecular theory of heat, and derive and apply expressions for the mean free path and pressure of an ideal gas.
5. Explain the term "ultraviolet catastrophe" and analyze Planck's law of blackbody radiation and the other laws of radiation derived from it.
6. Describe the basic concepts of thermodynamics (thermodynamic system, environment, closed system, isolated system, extensive and intensive thermodynamic parameters, equilibrium, reversible and irreversible processes).
7. Derive the equation of state of an ideal gas and analyze the equation for real gasses (Van der Waals equation).
8. Formulate and apply the laws of thermodynamics (calculate the work done by different changes of state of the gas, analyze the work done by heat engines and refrigerators, determine the entropy change for different systems).
9. Compare heat capacities and derive the relationship between them. Estimate the relationship between heat capacities at constant volume and pressure. Describe and apply the mixing method to determine the unknown heat capacity.
10. Explain the thermodynamic potentials and use them to calculate the volume, temperature, pressure, and entropy of the gas.
11. Analyze two bodies in thermal contact and describe the conditions under which a steady state of the system occurs and a system with a variable number of particles and describe the meaning of chemical potential.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures with demonstration experiments:
• (4 hours) Dynamical, thermodynamical and statistical description of many-particle systems
o Model of ideal gas
o Sketch diagrams of isothermal, isobaric, and isovolumic processes in the p,V diagram
• (4 hours) Internal energy
o Work</td></tr>
</table>

	o Heat o The first law of thermodynamics • (5 hours) Heat capacity o The importance of heat capacities in relation to experimental verification of theory o Mayer's relationship o The importance of the dependence of heat capacity on temperature for the development of quantum physics • (13 hours) Second Law of Thermodynamics o Kelvin's and Clausius's formulation of the second law of thermodynamics o Clausius relation o Definition of the second law of thermodynamics through the increase of entropy in closed system o The greatest utility and the greatest power of the circular process o Boltzmann's definition of entropy o Reversibility of dynamic processes and irreversibility of processes in nature o Gibbs definition of entropy o Shann's definition of information entropy. Difference between information entropy and thermodynamic entropy o Jayne's principle of maximum information entropy o Derivation of Gibbs distribution by Jayne's principle of maximum information entropy • (6 hours) The third law of thermodynamics o The impossibility of reaching the absolute zero temperature o Enthalpy and Gibbs free energy. Maxwell's relations. o Van der Waals equation of state of a real gas. Maxwell's construction. o Law of appropriate states. • (5 hours) Phase transitions o Definition of phase transitions. o Phase diagram, coexistence curves, Clausis-Clapeyron equation, boiling, dependence of saturated vapor pressure on temperature. • (2 hours) Solutions o Osmosis and vant Hoff's equation. o Rault's and Henri's law. • (8 hours) Exchanging-particles systems o Chemical potential and equilibrium state of systems exchanging particles. o Construction of phase diagram using chemical potential. o Gibbs distribution for exchanging-particles systems o Application to quantum systems with identical particles. Fermi-Dirac and o Bose-Einstein distribution. • (4 hours) Chemical reactions o Exothermic and endothermic reactions. o Law of mass action. o pH factor

• (4 hours) Surface effects
o Surface pressure.
o Metastable states and change in phase transition temperature on curved surfaces
• (5 hours) Transfer phenomena
o Mean free path
o Diffusion coefficients, thermal conductivity and viscosity of an ideal gas
o Poisseuille's formula

Exercises:
1. (2 hours) Statistics - introduction
2. (2 hours) Kinetic theory of ideal gases
3. (2 hours) Maxwellian distribution
4. (3 hours) Work and heat. The first law of thermodynamics, part I
5. (3 hours) Work and heat. The first law of thermodynamics, part II
6. (3 hours) Entropy, Part I
7. (3 hours) Entropy, part II
8. (3 hours) Van der Waals equation of state
9. (3 hours) Phase transitions
10. (2 hours) Joule-Thomson effect
11. (2 hours) Capillary pressure
12. (2 hours) Diffusion, conductivity and viscosity

Seminar topics:
• Thermal relaxation of gases during diffusion
• Classical mechanics, quantum mechanics and temperatures
• Measurement of macroscopic quantities
• Ideal gas in an external field and Boltzmann distribution
• Heat capacity of an ideal gas and heat capacity of a solid
• Adiabatic and polytropic processes
• The second law of thermodynamics and the equivalence of the two formulations
• Stirling engine
• Working principle of an internal combustion engine
• Functioning of the refrigerator
• Statistical interpretation of entropy
• Information entropy and the Shannon theorem
• Sackur-Tetrode equation
• Thermodynamic potentials
• Stability of thermodynamic systems
• Van der Waals equation

	• Phase transitions and the Clausius-Clapeyron equation • Phase diagram; the concept of critical points and triple points • Osmotic pressure • Raoult's law • Quantum mechanical systems • Surface phenomena • Nature of metastable states • Entropy as an arrow of time • Entropy of the universe • Free topic (within the scope of the course content)
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☑ Workshops ☐ ☐ ☐
Student obligations	Preparation of a term seminar work. Class participation.

Monitoring student work

Class attendance	3.5	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper	0.5		
Colloquiums		Oral exam	2.5		
Written exam	2.5	Project			

Assessment and evaluation of student work	Twice during the semester, students take a written pre-exam (first part: including “Entropy”, the second part: from “Entropy” on). Students that reach more than 50% of possible points were acquitted of taking the written exam and can access the oral exam directly. Furthermore, those students that in the first written pre-exam achieve 50% points or more, can take the oral exam in two parts (first part includes materials up to “The third law of thermodynamics”, must be taken immediately after the first written pre-exam). The final grade is based on written (pre-)exam (40% of the score), the seminar essay (15% of the score) and the oral exam (45% of the score).

Required literature

Title	Number of copies available	Availability on other medium
P. Županović: Termodinamika s elementima statističke fizike, Element, Zagreb, 2016.	25	

Supplementary literature	[1] H. D. Young, R. A. Freedman, Sears and Zemansky's university physics: with modern physics, 13th ed., Addison Wesley, 2012.

	[2] P. Kulišić, Mehanika i toplina, Školska knjiga, Zagreb 2005
Quality assurance	1. Lecturers who have subjects with correlated learning outcomes work together to ensure quality of learning. 2. Statistics of test scores and assessment of performance in accordance with established learning outcomes. 3. Evaluation of students through an anonymous survey conducted in accordance with the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Irreversible Process Thermodynamics</td></tr>
<tr><td>ID</td><td>PMP20C</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Larisa Zoranić</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Get acquainted with the physical description of non-equilibrium processes through thermodynamics and statistical physics and its application in the research of biological systems.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Outcomes of undergraduate studies, especially related to equilibrium thermodynamics, statistical physics and classical mechanics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After successfully completing the course, the student will be able to:
1. recognize and define the basic concepts of non-equilibrium thermodynamics
2. derive the mass, energy and momentum transfer equations for ideal and non-ideal fluids
3. derive the entropy transfer equation and discuss the production of entropy
4. define the basic postulates of the linear approach in non-equilibrium thermodynamics, and establish and apply Onsager's relations
5. discuss non-equilibrium processes such as diffusion, thermal conductivity and chemical reactions
6. apply a statistical-mechanical approach in the description of non-equilibrium phenomena
7. recognize the importance of applying the ideas of non-equilibrium thermodynamics and statistical mechanics in the research of biological systems and beyond</td></tr>
<tr><td>Syllabus</td><td colspan="6">The timetable worked out according to the weekly plan:
1. Introduction to the course, equilibrium thermodynamics, system, state, process, properties, thermodynamic laws, entropy, direction of time
2. Irreversible and reversible processes, concept of local equilibrium, equilibrium and stability
3. Mass transfer equation, energy transfer equation, balance equations
4. Entropy transfer equation, rate of entropy generation (entropy production), dissipative function, thermodynamic coupling, Benard cell example of dissipative structure
5. Ideal fluids, Euler equation, adiabatic equation, conditions for equilibrium and stability (convection), stationary state
6. Energy transfer equation, momentum transfer equation, incompressible fluids, viscous fluids, Navier-Stokes equation
7. Energy transfer equation with viscosity, energy dissipation, heat transfer equation
8. Diffusion, relaxation time, examples of thermodynamic coupling
9. Postulates of linear non-equilibrium thermodynamics, entropy production equation, stationary state
10. Linear relationship between flow and force, Onsager relations, examples of coupling of heat transfer and diffusion</td></tr>
</table>

	11. Time variation of entropy production, principle of minimum entropy production 12. Statistical-mechanical approach, Brownian motion, Langevin equation 13. Stochastic processes, Fokker-Planck equation 14. Fluctuation-dissipation theorem 15. Elective topic, applications in biophysics, economics, chemical kinetics and the like.
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Attendance and commitment of students in class, solving tasks in class and at home. Participation in class discussions and debates.

Monitoring student work						
Class attendance	2	Research		Practical work		
Experimental work		Paper				
Essay		Seminar paper	0.5			
Colloquiums	1.5	Oral exam	2			
Written exam		Project				

Assessment and evaluation of student work	Knowledge is tested by a written and oral exam. Colloquiums are organized during classes. Students who do not pass the written part through the colloquium have 4 additional exam deadlines for passing the written part. The oral exam is taken after passing the written part in the form of a written and oral presentation of the seminar.

Required literature

Title	Number of copies available	Availability on other medium
Nonequilibrium Thermodynamics Transport and Rate Processes in Physical, Chemical and Biological Systems, Yasar Demirel, 2014 Elsevier B.V.		online
Fluid mechanics L.D. Landau and E. M. Lifshizt, Volume 6 of Course of Theoretical Physics, Pergamon press 1987.		online
Statistical mechanics-3rd ed. R. K. Pathria, Paul D. Beale, 2011 Elsevier Ltd.		online

Supplementary literature	Modern thermodynamics, from heat engines to dissipative structures D. Kondepudi, I. Prigogine: JOHN WILEY AND SONS, 1998. P. Županovic: Thermodynamics with elements of statistical physics, Element, Zagreb, 2016. Scientific articles, lectures

Quality assurance	The success of the program is monitored by the quality of knowledge demonstrated in the exams as well as by assessing the enthusiasm shown for the subject. External evaluation includes student surveys. Statistics of exam results and student evaluation through an anonymous survey on at the end of the course performance. The survey is conducted according to the rules of the University of Split
Other (in the opinion of the proponent)	

Subject name	Physical Education I		
ID	PMS131	Study year	1.
Lecturer	prof. dr. sc. Mladen Hraste	Points value (ECTS)	0.5
Associates		Class execution (number of hours in semester)	L: 0, S: 0, E: 30, P: 0
Subject status	Compulsory	Online percentage	0%

Subject description	
Subject goals	The main aims of the subject are to maintain and improve the health of students, raise their quality of life and study, acquire a permanent habit and custom to exercise through the optimization of all anthropological characteristics.
Enrolment requirements	There are no requirements for subject enrolling. There are no entry competences required for the course.
Learning outcomes	After completing the course students will be capable: o better mental and physical health o to maintain and to develop the health status by applying of exercise o to implement physically active lifestyle o to promote the value of an active and healthy lifestyle
Syllabus	1st teaching topic (2 hours): learning and improvement biotic movement structures 1; develop and maintain aerobic abilities 2ndt teaching topic (2 hours): learning and improvement biotic movement structures 2; develop and maintain aerobic abilities 3rd teaching topic (2 hours): learning and improving fitness program 1 and / or learning and improving basic movement structures of chosen kinesiological activities; develop and maintain aerobic abilities 4th teaching topic (2 hours): learning and improving fitness program 1 and / or learning and improving specific movement structures of chosen kinesiological activities; develop and maintain aerobic abilities 5th teaching topic (2 hours): learning and improving fitness program 1 and / or learning and improving basic technical elements 1 of chosen kinesiological activities; develop and maintain aerobic abilities 6th teaching topic (2 hours): learning and improving fitness program 1 and / or learning and improving basic technical elements 2 of chosen kinesiological activities; develop and maintain aerobic abilities 7th teaching topic (2 hours): learning and improving fitness program 1 and / or learning and improving basic technical elements 3 of chosen kinesiological activities; develop and maintain mixed aerobic-anaerobic abilities 8th teaching topic (2 hours): learning and improving fitness program 2 and / or learning and improving basic technical elements 4 of chosen kinesiological activities; develop and maintain mixed aerobic-anaerobic abilities 9th teaching topic (2 hours): learning and improving fitness program 2 and / or learning and improving basic tactical elements 1 of chosen kinesiological activities; develop and maintain mixed aerobic-anaerobic abilities 10th teaching topic (2 hours): learning and improving fitness program 2 and / or learning and improving basic tactical elements 2 of chosen kinesiological activities; develop and maintain mixed aerobic-anaerobic abilities

	11th teaching topic (2 hours): learning and improving fitness program 2 and / or learning and improving basic tactical elements 3 of chosen kinesiological activities; develop and maintain mixed aerobic-anaerobic abilities 12th teaching topic (2 hours): learning and improving fitness program 3 and / or learning and improving basic tactical elements 4 of chosen kinesiological activities; develop and maintain anaerobic alactate abilities 13th teaching topic (2 hours): learning and improving fitness program 3 and / or learning and improving complex technical elements 1 of chosen kinesiological activities; develop and maintain anaerobic alactate abilities 14th teaching topic (2 hours): learning and improving fitness program 3 and / or learning and improving complex technical elements 2 of chosen kinesiological activities; develop and maintain anaerobic alactate abilities 15th teaching topic (2 hours): learning and improving fitness program 3 and / or learning and improving complex tactical elements 1 of chosen kinesiological activities; develop and maintain anaerobic alactate abilities					
Teaching types	☐ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐			
Student obligations	Students are required to attend a minimum of 24 out of 30 planned hours (80%).					
Monitoring student work	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	The subject does not have grading. During the classes a motor movement of students will be positively evaluated if it performed flawlessly, easily and harmoniously; flawless, easy and consistent, but a bit "harder"; with minor errors and with less difficulty. During the classes a motor movement of students will not be positively evaluated if it is done with large errors and with great difficulty or can not perform a motor task is not in the elemental form.					
Required literature	Title	Number of copies available	Availability on other medium			
	http://www.pmfst.hr/~mhraste/ Priručnik iz kolegija Tjelesna i zdravstvena kultura					
Supplementary literature						
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split					

Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Physical Education II</td></tr>
<tr><td>ID</td><td>PMS132</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Mladen Hraste</td><td>Points value (ECTS)</td><td colspan="4">0.5</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>0</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The main aims of the subject are to maintain and improve the health of students, raise their quality of life and study, acquire a permanent habit and custom to exercise through the optimization of all anthropological characteristics.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">There are no requirements for subject enrolling.
There are no entry competences required for the course.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After completing the course students will be capable:
o better mental and physical health
o to maintain and to develop the health status by applying of exercise o to implement physically active lifestyle
o to promote the value of an active and healthy lifestyle</td></tr>
<tr><td>Syllabus</td><td colspan="6">1st teaching topic (2 hours): learning and improvement biotic movement structures 1; develop and maintain aerobic abilities
2ndt teaching topic (2 hours): learning and improvement biotic movement structures 2; develop and maintain aerobic abilities
3rd teaching topic (2 hours): learning and improving fitness program 1 and / or learning and improving basic movement structures of chosen kinesiological activities; develop and maintain aerobic abilities
4th teaching topic (2 hours): learning and improving fitness program 1 and / or learning and improving specific movement structures of chosen kinesiological activities; develop and maintain aerobic abilities
5th teaching topic (2 hours): learning and improving fitness program 1 and / or learning and improving basic technical elements 1 of chosen kinesiological activities; develop and maintain aerobic abilities
6th teaching topic (2 hours): learning and improving fitness program 1 and / or learning and improving basic technical elements 2 of chosen kinesiological activities; develop and maintain aerobic abilities
7th teaching topic (2 hours): learning and improving fitness program 1 and / or learning and improving basic technical elements 3 of chosen kinesiological activities; develop and maintain mixed aerobic-anaerobic abilities
8th teaching topic (2 hours): learning and improving fitness program 2 and / or learning and improving basic technical elements 4 of chosen kinesiological activities; develop and maintain mixed aerobic-anaerobic abilities
9th teaching topic (2 hours): learning and improving fitness program 2 and / or learning and improving basic tactical elements 1 of chosen kinesiological activities; develop and maintain mixed aerobic-anaerobic abilities
10th teaching topic (2 hours): learning and improving fitness program 2 and / or learning and improving basic tactical elements 2 of chosen kinesiological activities; develop and maintain mixed aerobic-anaerobic abilities</td></tr>
</table>

<table>
<tr><td></td><td>11th teaching topic (2 hours): learning and improving fitness program 2 and / or learning and improving basic tactical elements 3 of chosen kinesiological activities; develop and maintain mixed aerobic-anaerobic abilities
12th teaching topic (2 hours): learning and improving fitness program 3 and / or learning and improving basic tactical elements 4 of chosen kinesiological activities; develop and maintain anaerobic alactate abilities 13th teaching topic (2 hours): learning and improving fitness program 3 and / or learning and improving complex technical elements 1 of chosen kinesiological activities; develop and maintain anaerobic alactate abilities 14th teaching topic (2 hours): learning and improving fitness program 3 and / or learning and improving complex technical elements 2 of chosen kinesiological activities; develop and maintain anaerobic alactate abilities 15th teaching topic (2 hours): learning and improving fitness program 3 and / or learning and improving complex tactical elements 1 of chosen kinesiological activities; develop and maintain anaerobic alactate abilities</td></tr>
<tr><td>Teaching types</td><td><table><tr><td>☐ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr></table></td></tr>
<tr><td>Student obligations</td><td>Students are required to attend a minimum of 24 out of 30 planned hours (80%).</td></tr>
<tr><td>Monitoring student work</td><td><table>
<tr><td>Class attendance</td><td>0.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Assessment and evaluation of student work</td><td>The subject does not have grading.
During the classes a motor movement of students will be positively evaluated if it performed flawlessly, easily and harmoniously; flawless, easy and consistent, but a bit "harder"; with minor errors and with less difficulty. During the classes a motor movement of students will not be positively evaluated if it is done with large errors and with great difficulty or can not perform a motor task is not in the elemental form.</td></tr>
<tr><td>Required literature</td><td><table><tr><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr><tr><td colspan="3">-</td></tr></table></td></tr>
<tr><td>Supplementary literature</td><td>http://www.pmfst.hr/~mhraste/ Priručnik iz kolegija Tjelesna i zdravstvena kultura</td></tr>
<tr><td>Quality assurance</td><td>Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">Toxicology</td></tr>
<tr><td>ID</td><td>PMB735</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Viljemka Bučević Popović</td><td>Points value (ECTS)</td><td colspan="4">3.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Getting acquainted with the basic principles of toxicology and the toxicological properties of selected groups of harmful substances.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">There are no prerequisites for enrolment.
Entry competencies required for following the course successfully:
- knowledge of the chemical properties of inorganic and organic compounds
- knowledge of the structure and functioning of the main organ systems in human body</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">After completing the course, the student will be able to:
-Compare the main pathways for absorption of toxic substances into the human body, their distribution, metabolism and excretion.
-Interpret dose and effect ratio, distinguish acute from chronic toxicity, classify harmful substances according to toxicological data
-Assess the toxicity of different groups of substances (gases, solvents, metals, etc.)
-Apply protective measures against chemicals in laboratory work
-Discuss effects of potentially harmful substances in the everyday environment (pesticides, natural toxins, nutritional supplements, etc.)</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures:
1. Toxicology - description and history. (1 hour)
2. Absorption of harmful substances into the human body. Distribution and excretion of harmful substances (3 hours)
3. Biotransformation: phase I and phase II reactions. Exposure to toxic substances. (3 hours)
4. Dose-Effect Ratio. Types of adverse effects - general toxicity. (1 hour)
5. Classification of harmful substances. (1 hour)
6. Mutagenicity and carcinogenicity. (2 hours)
7. Reproductive toxicity. Ecotoxicity. (2 hours)
8. Risk Assessment, Danger and Safety. (1 hour)
9. Toxic effect of gases: suffocants and irritants. (2 hours)
10. Toxic effects of metals and metal containing substances. (2 hours)
11. Toxic organic substances. (4 hours).
12. Harmful effects of ionizing radiation. (2 hours)</td></tr>
</table>

	13. Protection measures against harmful chemicals in laboratory. (2 hours) 14. Selected examples of exposures to harmful substances in everyday life. (4 hours)
Teaching types	☑ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring
Student obligations	Attending classes, seminar on selected topic, exam

Monitoring student work					
Class attendance	1	Research		Practical work	
Experimental work	0	Paper			
Essay		Seminar paper	0.5		
Colloquiums		Oral exam	1.5		
Written exam		Project			

Assessment and evaluation of student work	20% seminar 80% exam

Required literature

Title	Number of copies available	Availability on other medium
Lectures as pdf files.		

Supplementary literature	C.D. Klaassen (ur.), Casarett and Doull's Toxicology – The Basic Science of Poisons., 6. izd., McGraw-Hill, 2001.
Quality assurance	The quality of teaching will be monitored by collecting feedback from students through personal consultations, joint conversations and anonymous student surveys. The students' performance in the final exam will be analyzed and used to improve the teaching performance in the next academic year.
Other (in the opinion of the proponent)	

Subject name	Three-dimensional design of physical objects		
ID	PMII70	Study year	2.
Lecturer	doc. dr. sc. Ivan Peko	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 30, P: 0
Subject status	Elective	Online percentage	0%
Subject description			
Subject goals	Introduction to 3D modeling and object design. Students should be able to use tools for 3D modeling and object design.		
Enrolment requirements	-		
Learning outcomes	1. Introduction to 3D modeling and object design tools 2. 3D object representation: drawing and profile 3. Introduction to projections 4. Mirroring, symmetry and their use in computer design 5. Computer implementation of spline and their use		
Syllabus	1. Drawing as a basis for 3D object 2. Profile extrusions & Edit profile 3. Profile and drawings 4. Degrees of freedom and constraints on profile 5. Object rotation and revolution 6. Geometric projections 7. Line construction, Centerline & Mirror 8. Extruded cut 9. Multiple object construction 10. Screws and screw threads 11. Shell 12. 2D and 3D splines and their use 13. Smoothing: chamfers and fillets 14. Introduction to Blender 15. 3D printing		
Teaching types	☑ Lectures ☐ Seminars ☐ Exercises ☐ Fully online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☑ Laboratory	☐ ☐ ☐ ☐

	☐ Combined online		☐ Mentoring			
Student obligations	Participate in course activities. Homework. Exam.					
Monitoring student work	Class attendance	1	Research		Practical work	1
	Experimental work	1	Paper			
	Essay		Seminar paper	1		
	Colloquiums		Oral exam			
	Written exam		Project	1		
Assessment and evaluation of student work	Student activities in class (20%) Project (40%) Exam (40%)					
Required literature	Title				Number of copies available	Availability on other medium
	Lecture notes in 3D modeling, Hrvoje Kalinić					
Supplementary literature	Lecture notes available on the Internet including solved problems and additional links Matt Lombard: Solidworks 2009 Bible, Wiley Publishing, Inc Dassault Systems Solidworks Corporation: Solidworks 2010, Soldiworks Essentials					
Quality assurance	Students feedback, students results and self-evaluation					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">Classroom management</td></tr>
<tr><td>ID</td><td>PMS160</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>Antonija Bašić, pred.</td><td>Points value (ECTS)</td><td colspan="4">2.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>15</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Course objectives are training students for high-quality decision-making in the learning process with special emphasis on creating quality teaching atmosphere and environment, acquiring knowledge and skills which can help them prevent and resolve conflicts in a variety of teaching situations and train them for high-quality classroom management as well as for conducting parent-teacher conferences and meetings</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6"></td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon completion of the course, the student will be able to:
1. recognize, differentiate and evaluate different teaching and educational styles
2. understand, analyze and evaluate determinants of quality teaching environment and communication, namely classroom environment
3. define, assess and evaluate characteristics of effective teaching process
4. understand, differentiate and evaluate causes of indiscipline in schools, and ways to motivate students depending on their developmental characteristics
5. understand, differentiate and evaluate ways of achieving discipline in the teaching process taking into account developmental characteristics of students, and improve competences in handling a variety of teaching situations
6. organize high-quality parent-teacher conferences and meetings.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1.The relationship between traditional and modern school with regard to the participants' role in the teaching process, methods of acquiring knowledge and skills; curricular, competence- based and co- constructivist approach to building modern school (2L)
2. features of effective teaching process in modern school (1L)
3. classroom management with respect to developmental characteristics of students (age, gender, social, emotional, health) (2L)</td></tr>
</table>

	4. teacher's teaching and educational styles (1L) 5. motivation in modern education process (1L) 6. assessment impact on the quality of the classroom environment (1L) 7. characteristics of teaching atmosphere and environment in modern teaching process and in major reform pedagogies (2L) 8. effective teaching communication (1L) 9. Causes of school discipline and establishing discipline in the teaching process (2L) 10. organization of parent – teacher conference 11. parent–teacher meetings (1L) Seminars are organized as workshops in which students prepare, critically cogitate and discuss issues, current events and problems important for classroom management and plan new strategies of prevention and resolution of detected problems. In the implementation of the seminar active participation, cooperative learning and teamwork are expected from students.
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Students are, in accordance with the existing regulations, obliged to participate in all forms of instruction.

Monitoring student work						
Class attendance	1	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper	0.5		
Colloquiums		Oral exam	0.5		
Written exam		Project			

Assessment and evaluation of student work	Assessment of knowledge, skills and competence is carried out during the semester by evaluating students' activities during lectures and seminars, including oral examination.

Required literature	Title	Number of copies available	Availability on other medium

	Ilić, I.; Ištvanić, I.; Letica, J.; Sirovatka, G.; Vican, D. (2012), Upravljanje razredom. Zagreb: Agencija za strukovno obrazovanje i obrazovanje odraslih u suradnji s British Councilom.		dostupno
	Vizek Vidović, V.; Rijavec, M.; Vlahović –Štetić, V.; Miljković, D: (2014), Psihologija obrazovanja. Zagreb: IEP VERN. (odabrana poglavlja)		
	Kyriacou, C. (2001), Temeljna nastavna umijeća. Zagreb: Educa. (odabrana poglavlja)		
Supplementary literature	Jensen, E. (2003), Super nastava. Zagreb: Educa. Glasser, W. (1995), Nastavnik u kvalitetnoj školi. Zagreb: Educa. Ajduković, M.; Pečnik, N. (20029, Nenasilno rješavanje sukoba. Zagreb: Alinea. Bičanić, J. (20019, Vježbanje životnih vještina. Priručnik za razrednike. Zagreb: Alinea Matijević, M. (2001), Alternativne škole. Zagreb: Tipex. Matijević, M.; Radovanović, D. (2011), Nastava usmjerena na učenika. Zagreb: Školske novine.		
Quality assurance	Advisory hours, conversation, active participation, evaluation conducted by the Quality Assurance Board		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Introduction to Atomic and Molecular Physics</td></tr>
<tr><td>ID</td><td>PMP204</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Martina Požar</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>30</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Understanding atomic and molecular structure, and how it manifests itself in spectra. Understanding how symmetry can be applied to objects like molecules and how group theory can help us predict the normal modes of molecules</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Learning outcomes planned for the subjects: General physics; Quantum physics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. To understand group theory and apply it to the calculation of normal modes of molecules, hybridization of molecular orbitals
2. To derive and use the results of angular momentum algebra.
3. To describe and analyze the spectrum of hydrogen atoms and compare it with other spectra alkaline elements.
4. To understand the electronic structure of atoms and the processes that take place there, with the aim of interpreting the spectrum.
5. To analyze the interaction of atoms with stationary and homogeneous electrical and magnetic fields.
6. To discuss the basic properties of atomic and molecular orbitals. To calculate the electronic structure of molecules, understand the construction of molecular orbitals and the hybridization of molecular orbitals
7. To describe common experimental techniques and measuring instruments in
atomic and molecular physics and applications of atomic and molecular physics in others branches of physics and areas of science.
8. To describe the nature of various molecular degrees of freedom.
9. To draw conclusions about the atomic and molecular structure based on the provided spectra.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Group theory: introduction. Symmetry operations, multiplication table.
2. Group theory: C2V – example of water. Matrix representations of symmetry operations, character table. Great and little orthogonality theorems.
3. Group theory: character table and application to the water molecule. Normal modes of the water molecule and the spectrum. C3V – example of ammonia.
4. Group theory: C3V – example of ammonia. SALC. Character table. Normal modes of the ammonia molecule and spectrum.
5. Group theory: Td – example of methane, normal modes. Using hodograms on examples.
6. Theory of groups: Direct product groups. Projection operator. Vanishing integrals.
7. Angular momentum: spin. Bonded and unbonded bases.
8. Atomic structure and spectrum: Hydrogen atom. SO bonding.</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">9. Atomic structure and spectrum: Hydrogen atom – detailed spectrum, terms.
10. Atomic structure and spectrum: Helium atom – detailed spectrum, terms.
11. Atomic structure and spectrum: Spectral terms for atoms with more electrons. Transitions, selection rules. Hund's rules. Normal Zeeman effect.
12. Atomic structure and spectrum: Paschen–Back effect. Stark effect.
13. Molecular structure and spectrum: Born–Oppenheimer approximation. H2+ molecule. Theory of molecular orbitals.
14. Molecular structure and spectrum: Diatomic molecules. Hybridization of orbitals (group theory).
15. Molecular structure and spectrum: Huckel's method.</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Attending classes. Preparing and presenting the seminar paper. Passed written exam (exercises) and oral exam (theoretical explanations). Success in each part at least 40%.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>1</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>2</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Students' work is evaluated through: the creation and presentation of a seminar paper, a written exam and an oral exam.</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">P. Atkins, R. Friedman: Molecular Quantum Mechanics, Oxford, 2007.</td><td></td><td></td></tr>
<tr><td colspan="4">N. Zettilli, „Quantum Mechanics: Concepts and Applications”, Wiley & sons, 2001.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">A. Vincent, „Molecular Symmetry and Group Theory”, Wiley & sons, 2013.

P. Atkins, J. De Paula, R. Friedman, „Quanta, Matter, and Change: A Molecular Approach to Physical Chemistry”, Oxford University Press, 2008.</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Regular verification of the achievement of the expected learning outcomes during classes.</td></tr>
</table>

	Statistics of exam results and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Introduction to differential geometry</td></tr>
<tr><td>ID</td><td>PMM120</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Tea Martinić Bilać</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Goal of this course is to familiarize students with basic terms of differential geometry such as theory of curves in space (and on plane) and theory of surfaces in Euclid space. Thus, students will be able to understand more advanced course in differential geometry which would contain Riemann geometry and multiplicity. Furthermore, application of acquired knowledge is possible in other science fields, eg. in physics.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Required competences: knowledge of mathematical analysis and linear algebra.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Student will be able to:

-define regular curves and surfaces

-explain curvature and torsion of a curve

-apply first and second fundamental form of surface

-analyse surface using normal, Gaussian and mean curvature</td></tr>
<tr><td>Syllabus</td><td colspan="6">-Regular curve (1)

-Lengths of curves (1)

-Curvature and torsion (2)

-Frenet formuleas (2)

-Fundamental theorem of space curves (2)

-Regular surfaces (1)

-Tangent plane to regular surface (2)</td></tr>
</table>

	–First fundamental form of surface. (2) –Orientation of surface (1) –Second fundamental form of surface. (2) –Normal curvature (2) –Gaussian and mean curvature (2) –Special curves on surfaces: line of curvature, asymptotic curve and geodesic. (2) –Locally isometric surfaces (2) – Theorema Egregium. (2) – Fundamental theorem of surfaces in space (2) – Gauss–Bonnet theorem. (2)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Attending classes and homework assignments.

Monitoring student work						
	Class attendance	2	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam	2		
	Written exam	2	Project			

Assessment and evaluation of student work	Written and oral exam.

Required literature	Title	Number of copies	Availability on other medium

<table>
<tr><td rowspan="2"></td><td></td><td>available</td><td></td></tr>
<tr><td>N. Ujević, Predavanja iz uvoda u diferencijalnu geometriju, skripta.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">1.M. P. Do Carmo, Differential Geometry of Curves and Surfaces, Prentice-Hall, 1976.

2.R.S. Millman, G.D. Parker, Elements of Differential Geometry, Prentice-Hall Inc., New Jersey/London, 1977.</td></tr>
<tr><td>Quality assurance</td><td colspan="3">Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

Subject name	Introduction to financial mathematics						
ID	PMM505	Study year	2.				
Lecturer	dr. sc. Ana Perišić	Points value (ECTS)	5.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	0	30	0	
Subject status	Elective	Online percentage	30%				
Subject description							
Subject goals	An introduction to fundamental concepts of financial mathematics required for understanding and correct interpretation of mathematical models in finance. Acquiring essential financial modelling skills through presentation of applied mathematical techniques in financial practice covered by many examples.						
Enrolment requirements							
Learning outcomes	Students will be able to: - explain the concept of the time value of money, - differentiate between nominal, proportional and effective interest rate, - calculate and interpret present and future values of cash flows, - construct amortization schedules for different loan repayment methods, - apply basic capital budgeting techniques and compare investment projects, - evaluating bonds and bond portfolios, - explain basic concepts of financial derivatives, arbitrage and replicating portfolio, - carrying out basic calculations in financial mathematics in a computer-supported way. - model and solve basic problems in economics and finance.						
Syllabus	Lectures/Exercises: 1. Time value of money, simple and compound interest types of interest rates. (3) 2. Present and future values of cash flows; general annuities, perpetuities. (3) 3. Continuously compounded interest. (2) 4. Loan. Different loan repayment methods. Rescheduled loans. (3) 5. Intercalary interest. Effective interest. (2) 6. Partial exam. (1) 7. Capital budgeting techniques. Return. (3) 8. Bond: value, price, yield. (2) 9. Duration. Duration of a portfolio of bonds. (2) 10. Immunization. Convexity. (2) 11. Term structure of interest rates. (1) 12. Arbitrage. (1)						

	13. Financial derivatives, replicated portfolio. (3) 14. Partial exam. (1)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Attending lectures, writing homework, written and oral exam. During the semester, students have the possibility to partially take written exams through colloquia (twice during the semester). Students who pass both colloquia don't need to take part in the written exam.

Monitoring student work

Class attendance		Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam			
Written exam		Project			

Assessment and evaluation of student work

Required literature

Title	Number of copies available	Availability on other medium
J. Cvitanić, F. Zapatero, Economics and Mathematics of Financial Markets, The MIT Press, 2004		
S. Benninga, Financial modeling, 3rd ed, The MIT Press, Cambridge, 2008		
Šegota, A. Financijska matematika, Sveučilište u Rijeci, 2012.		
Babić, Z., Tomić-Plazibat, N., Poslovna matematika, Ekonomski fakultet, Split, 2004.		

Supplementary literature	J. Cvitanić, F. Zapatero, Economics and Mathematics of Financial Markets, The MIT Press, 2004 S. Benninga, Financial modeling, 3rd ed, The MIT Press, Cambridge, 2008 Šegota, A. Financijska matematika, Sveučilište u Rijeci, 2012. Babić, Z., Tomić-Plazibat, N., Poslovna matematika, Ekonomski fakultet, Split, 2004.
Quality assurance	Summarizing test results and conducting an anonymous student survey at the end of the course. The survey is conducted according to the rules of the University of Split.

Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Introduction to Physics</td></tr>
<tr><td>ID</td><td>PMP096</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Martina Požar</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Acquire knowledge and understanding of the basics in mechanics, physics of condensed matter, optics and quantum physics. Acquire computational knowledge in solving physical problems and develop competence in construction of mathematical models for real mechanical problems</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Enrollment in the 1st year of undergraduate study</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon passing the course on Introduction to physics, the student will be able to:
1. demonstrate knowledge of the kinematics of motion in one, two and three dimensions;
2. identify and explain Newton's laws of motion and apply them in numerical problems;
3. explain the concepts of work , kinetic and potential energy, momentum and impulse and apply the laws of conservation of energy and momentum in realistic examples;
4. demonstrate knowledge of kinematics and dynamics of rigid bodies rotations and solve simple problems involving the rotation of a rigid body;
5. identify and explain Newton's law of gravitation and Kepler’s laws and apply them in the description of the Solar system
6. identify and explain the properties of solids, liquids and gases and solve problems in hydromechanics;
7. explain the motion of a simple harmonic oscillator and describe the propagation of waves, the interference, the resonance and the Doppler effect;
8. demonstrate the knowledge of optics in solving problems;
9. identify and explain Plack's radiation law and the photoelectric effect.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures per weeks (15 weeks in total):
1. Units and physical quantities (2L+1E)
2. Motion along a straight line (2L+1E)
3. Motion in two or three dimensions (4L+1E)
4. Newton's laws of motion (4L+1E)</td></tr>
</table>

<table>
<tr><td></td><td>5. Applying Newton's laws (3L+1E)
6. Work and kinetic energy (3L+1E)
7. Potential energy and energy conservation (3L+1E)
8. Momentum, impulse, and collisions (3L+1E)
9. Rotation of Rigid Bodies (6L+1E)
10. Newton's law of gravitation and Kepler's laws (2L+1E)
11. Solids, liquids and gases (3L+1E)
12. Oscillations (2L+1E)
13. Waves (2L+1E)
14. Optics (3L+1E)
15. Introduction to Quantum Physics (3L+1E)</td></tr>
<tr><td>Teaching types</td><td><table><tr><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr></table></td></tr>
<tr><td>Student obligations</td><td>Students have to attend at least 70% of the lectures and 80% of the exercises.
Students have to solve at least 50% from each of the two written partial exams or to solve 50% from the final written exam. Students have to pass an oral exam.</td></tr>
<tr><td>Monitoring student work</td><td><table>
<tr><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>1</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>1</td><td>Project</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Assessment and evaluation of student work</td><td>Contribution to the final grade:
1. written exam (or two partial exams) – 50%
2. oral exam – 50%</td></tr>
<tr><td>Required literature</td><td><table>
<tr><th>Title</th><th>Number of copies available</th><th>Availability on other medium</th></tr>
<tr><td>[1] D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics. 9th Edition, John Wiley, New York 2011.</td><td>21</td><td></td></tr>
</table></td></tr>
<tr><td>Supplementary literature</td><td>[1] P. G. Hewitt, Conceptual Physics, 12th Edition, Pearson 2010.</td></tr>
</table>

	[2] H. D. Young, R. A. Freedman, Sears and Zemansky's University Physics, 12th Edition, Pearson, 2008
Quality assurance	Statistics of the exam results and student evaluation via an anonymous survey conducted by the University of Split
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Introduction to Geophysics</td></tr>
<tr><td>ID</td><td>PMP160</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Jadranka Šepić</td><td>Points value (ECTS)</td><td colspan="4">4.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>15</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Provide knowledge on
· History of the Universe and the solar system
· The earth structure, tectonic processes, and earthquakes
· Ocean properties and ocean dynamics
· Atmospheric structure and dynamic</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Prerequisites
· Basic physics
· Basic chemistry
· Basic mathematics</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Understanding formation and evolution of the earth and the atmosphere
Knowledge on earthquake causes and practical solutions of calculating earthquake's epicenter
Calculations of ocean dynamics including tides
Understanding algorithms describing atmospheric processes</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Space and solar system 1
2. The sun 1
3. Formation of the earth 1
4. The moon and tides 1
5. Radiation laws 1
6. Structure of the earth 2
7. Plate tectonics 1
8. Seismic waves and earthquakes2
9. Seismology instruments 1
10. Main concepts of oceanography 2
11. Properties of the oceans and sea floor1
12. Structure of density, temperature, salinity, and motions in the ocean 2
13. Air-sea interaction 1
14. Winds and wind stress over the ocean 1
15. Oceanic heat budget 2</td></tr>
</table>

	16. Ocean exploration 1 17. Dominant forces for ocean dynamics and their modelling 1 18. Basic concepts of the atmospheric science 2 19. Atmospheric composition 1 20. Structure of atmospheric density, temperature, and pressure 2 21. Ideal gas law 1 22. Hydrostatic equilibrium in the atmosphere 1 23. Adiabatic processes in the atmosphere1
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☑ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring ☐ ☐ ☐ ☐
Student obligations	· Written exam · Oral presentation · Oral exam

Monitoring student work

Class attendance	1.5	Research		Practical work	
Experimental work		Paper		Domaći rad	1.0
Essay		Seminar paper	0.5		
Colloquiums		Oral exam	1		
Written exam		Project			

Assessment and evaluation of student work	· Written exam · Oral presentation · Oral exam

Required literature

Title	Number of copies available	Availability on other medium
Howell, B. F., Jr., 1978: Introduction to Geophysics. Robert E. Krieger Publishing. 400 pp.		
Stewart, R. H., 2008: Introduction to Physical Oceanography. Texas A & M University. 345 pp.		
Wallace J. M., and P. V. Hobbs, 2006: Atmospheric Science: An introductory Survey. 2nd ed., Academic Press. 483 pp.		

Supplementary literature	• Ahrens C. D. 2001. Essentials of Meteorology, An Invitation to the Atmosphere,

	Brooks/Cole Publishing. • Bolt, B.A., Inside the Earth, 1982. W.H. Freeman & Company, San Francisco, 191 pp. • Garland G.D., 1977. The Earth's Shape and Gravity, Pergamon Press, Oxford • Kasumović, M., 1971. Opća i primijenjena geofizika I. dio – Opća geofizika, Sveučilište u Zagrebu, Prirodoslovno-matematički fakultet, Zagreb, 1-148. • Merrill, R.T., McElhinny, M.W. and McFadden, P.L. 1998. The magnetic field of the Earth, Academic Press International Geophysics Series, 63 • Pickard, G.L., and W.J. Emery, 1990: Descriptive Physical Oceanography, An Introduction, 5th Edition, Pergamon Press, New York, 320 pp.
Quality assurance	1. Analysis of the acquired learning outcomes at the end of the class, compared with the work of students. 2. Monitoring the development of students in the subjects who followed the links with the success of the case 3. Other surveys of students
Other (in the opinion of the proponent)	

Subject name	Introduction to mathematical analysis						
ID	PMM151	Study year	1.				
Lecturer	doc. dr. sc. Marija Bliznac Trebješanin	Points value (ECTS)	8.5				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			45	0	60	0	
Subject status	Compulsory	Online percentage	20%				
Subject description							
Subject goals	The course objective is to acquaint the student with the properties of the space of real numbers and the concept and properties of sequences and series of real numbers and properties of real-valued functions such as continuity. In the first part of the course, they will observe the sequences and series of real numbers and examine their convergence. In the second part of the course, they will systematize the known properties of elementary functions and adopt the concepts of limit value and continuity of a real-valued function of a real variable. This will be applied to the demonstration of claims and proofs of the properties of continuous functions on a segment.						
Enrolment requirements	None.						
Learning outcomes	The student will be able to: - recognize algebraic and order properties of subsets of real numbers - distinguish and give examples of convergent and divergent sequences and series of real numbers; - give examples of subsequences of a given sequence of real numbers - apply the properties of limits of sequences of real numbers - apply series convergence tests - list elementary real-valued functions and determine their domains and images - find the limit of a function at a point and use this limit to determine continuity of a function in said point - determine and give examples of continuous and non-continuous functions						

	– list properties of continuous functions on a segment
Syllabus	The space of real numbers – 6 hours Sequences and series of real numbers (convergence, limits calculus, subsequences, series convergence tests) – 15 hours Elementary real-valued functions – 9 hours Limits and continuity of real-valued functions (definitions and characterizations, limits in the extended space of real numbers, properties of continuous functions) – 15 hours
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☑ On line testovi znanja ☐ ☐ ☐
Student obligations	Class and tutorial sessions attendance.

Monitoring student work:

Class attendance	3	Research		Practical work	
Experimental work		Paper		Grupni rad	1
Essay		Seminar paper			
Colloquiums		Oral exam			
Written exam	4.5	Project			

Assessment and evaluation of student work	At class lectures and tutorial sessions, students will have problem solving sessions (individual and group activity). Also, students will take short quiz tests during lectures and online. Both activities will be valued in the final grade but earning points in thiese activities is not mandatory for finishing the course. The final exam is taken in written and oral form. Passing grade on a written form of the exam is a requirement for taking the oral exam. The exam can be taken partially, during class. .

Required literature

Title	Number of copies available	Availability on other medium
G. B. Thomas, Thomas' Calculus, Pearson, 2016.,13. izdanje	2	da
S. Abbott, Understanding analysis, Springer-Verlag, New York, 2016., drugo izdanje	2	da

	B. Guljaš, Matematička analiza 1 i 2, skripta PMF -a u Zagrebu, 2018.		da
Supplementary literature	J. Stewart, D. Clagg, S. Watson, Calculus, Eraly Transcendetals, Cengage Learning, 2021., 8. izdanje R. Larson, B. Edwards, Calculus, Cengage Learning, 2016., 11. izdanje V. Matijević, Matematička analiza 1 i 2, skripta PMF-a u Splitu, 2020.		
Quality assurance	During the semester, anonymous surveys will be administered to students to determine which concepts have been least understood thus far, which will help instructors to adapt the course. Statistics of exam results and student evaluation through anonymous questionnaires at the end of the course. The survey will be conducted according to the rules of the University of Split.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Introduction to Mathematical Logic and Set Theory</td></tr>
<tr><td>ID</td><td>PMM700</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Goran Erceg
dr. sc. Dino Peran</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The main goal of this course is to give students a deeper insight into the foundations of mathematics in which Mathematical Logic, and especially one of its areas, axiomatic Set Theory, plays the most important role.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Entry competences: elementary Set Theory.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon successful completion of this course students will be able to:

– evaluate the development of Mathematical Logic in terms of its relation to the foundations of Mathematics, explain and evaluate historical role of Cantor’s naive approach to Set Theory

– define axiomatically Propositional Logic and First Order logic (Propositional Calculus PC and Deductive Calculus DC, Predicate Calculus PC)

– define axiomatically Set Theory using the Zermelo–Frankel system of axioms

– using resolution or tableau test satisfiability, validity and logical consequence, for a given formula find its prenex normal form, disjunctive normal form and conjunctive normal form

– give a formal proof of a formula within a calculus (PC or PD)

– compute cardinality of sets given in various ways

– apply cardinal and ordinal numbers arithmetic and order between cardinals and ordinals

– characterize order types of the sets N, Z, Q and R

– apply transfinite induction</td></tr>
<tr><td>Syllabus</td><td colspan="6">– Introduction: Historical overview (1)</td></tr>
</table>

	– Propositional Logic: syntax and semantics (2) – Normal forms (1) – Propositional Calculus (2) – Deductive Calculus (2) – First order theories. syntax and semantics (2) – Prenex normal form (1) – Predicate Calculus (1) – Cantor's "naive" approach to Set Theory. Paradoxes (1) – The Zermelo-Frankel system of axioms (2) – Relations and functions (1) – Inductive and transitive sets (1) – The Axiom of choice. The function of choice. A family of sets. The product of set family (1) – Finite and infinite sets (1) – Equipotent sets. Cardinal numbers. The Cantor-Bernstein theorem (1) – Countable sets (1) – Uncountable sets. Continuum. The continuum hypothesis (2) – Partial orders. Total orders. Isomorphisms of ordered sets. Order types (2) – Characterizations of the ordered sets N, Z, Q and R (2) – Well-ordered sets. Ordinal numbers. Transfinite induction. The Burali-Forti paradox (2)		
Teaching types	☑ Lectures	☐ Fieldwork	☐

	☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐
Student obligations	Attending classes.		

Monitoring student work	Class attendance	2	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums	1	Oral exam	2		
	Written exam		Project			

Assessment and evaluation of student work	Two partial written exams / one final written exam and final oral exam.

Required literature	Title	Number of copies available	Availability on other medium
	M. Vuković, Matematička logika 1, PMF, Zagreb, 2007.		
	V. Matijević, Uvod u teoriju skupova, skripta, PMF, Split, 2014.		
	P. Papić, Uvod u teoriju skupova, HMD, Zagreb, 2000.		

Supplementary literature	D. van Dalen, Logic and Structures, Springer-Verlag, 1997. E. Mendelson, Introduction to Mathematical Logic, D. Van Nostrand Company, Inc. Princeton, 1997. H.B. Enderton, Elements of Set Theory, Academic Press, New York, 1977P K. Kuratowski, A. Mostowski, Set Theory, PWN, Warszawa, 1968
Quality assurance	Summary feedback for the whole class after the exam. Anonymous student survey.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Introduction to Fluid Mechanics</td></tr>
<tr><td>ID</td><td>PMP261</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Bernarda Lovrinčević</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>30</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td colspan="4">20%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Understanding the physical properties of fluids and their influence on fluid kinematics, accurate application of the law of conservation of mass, momentum and energy to fluid flow, and application of mathematical tools needed to describe fluid flow.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">The student must have adopted the following learning outcomes:
· apply the laws of classical mechanics to a particle system
· apply the laws of conservation of momentum, angular momentum and energy
· solve problems of motion in one dimension and motion in a medium with resistance
· solve physical problems using Lagrange's and Hamilton's formulation of classical mechanics
· define and discuss the laws of thermodynamics
· understand the physical interpretations of differential operators
· use vector analysis in rectangular and curved coordinates
· explain the basics of tensor analysis
· apply methods for solving linear differential equations of the second order</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">· to classify fluids based on their physical properties
· to calculate the kinematic properties of the fluid element
· when describing fluid flow, to apply the laws of conservation of mass, momentum and energy
· to explain the formation of a boundary layer in a fluid
· to apply dimensional analysis to the obtained results</td></tr>
<tr><td>Syllabus</td><td colspan="6">The content is divided into the following twelve teaching units:
1. Lagrange and Euler's description of motion (2 hours of lectures and 2 hours of exercises)
2. Fluid properties (4 hours of lectures and 4 hours of exercises)
3. Fluid statics (4 hours of lectures and 4 hours of exercises)
4. Control volume (2 hours of lectures and 2 hours of exercises)
5. Laminar flow (2 hours of lectures and 2 hours of exercises)
6. Equation of continuity (2 hours of lectures and 2 hours of exercises)
7. The first law of thermodynamics for fluid (2 hours of lectures and 2 hours of exercises) 8. Viscosity (2 hours of lectures and 2 hours of exercises)
9. Motion equations for fluid (4 hours of lectures and 4 hours of exercises)</td></tr>
</table>

<table>
<tr><td></td><td>10. Turbulent flow (2 hours of lectures and 2 hours of exercises)
11. A boundary layer (2 hours of lectures and 2 hours of exercises)
12. Dimensional analysis (2 hours of lectures and 2 hours of exercises)</td></tr>
<tr><td>Teaching types</td><td><table><tr><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☑ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☑ domaće zadaće
☐
☐
☐</td></tr></table></td></tr>
<tr><td>Student obligations</td><td>Writing reports on the conducted experiments. Attendance.</td></tr>
<tr><td>Monitoring student work</td><td><table>
<tr><td>Class attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td>Domaće zadaće</td><td>0.5</td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>2</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>2</td><td>Project</td><td></td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Assessment and evaluation of student work</td><td>Twice during the semester, students take a written pre-exam. Students that reach more than 50% of possible points were acquitted of taking the written exam and can access the oral exam directly. Furthermore, those students that in the first written pre-exam achieve 50% points or more, can take the oral exam in two parts The final grade is based on written (pre-)exam (1/2 of the score) and the oral exam (1/2 of the score).</td></tr>
<tr><td>Required literature</td><td><table>
<tr><th>Title</th><th>Number of copies available</th><th>Availability on other medium</th></tr>
<tr><td>Philip J. Pritchard, John W. Mitchell, Fox and McDonald's Introduction to Fluid Mechanics John Wiley & Sons, 2011.</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Supplementary literature</td><td>D. J. Acheson
Elementary Fluid Dynamics
Clarendon Press, 2005.

Y. Nakayama & R. F. Boucher
Introduction to Fluid Mechanics
Butterworth, 2000.</td></tr>
<tr><td>Quality assurance</td><td>Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split</td></tr>
<tr><td>Other (in the opinion of the</td><td></td></tr>
</table>

proponent)	

Subject name	Introduction to Numerical Mathematics						
ID	PMM108	Study year	2.				
Lecturer	doc. dr. sc. Andrijana Ćurković	Points value (ECTS)	5.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	0	30	0	
Subject status	Compulsory	Online percentage	30%				
Subject description							
Subject goals	The aim of this course is to introduce basic concepts and results in numerical analysis such as: approximation, numerical integration and differentiation, numerical solutions of linear and nonlinear equations. Students will gain preliminary knowledge for advanced courses in numerical analysis and get insight in modern trends where numerical methods, based upon sound computational mathematics, are the basic algorithms underpinning computer predictions in modern science.						
Enrolment requirements	Enrolment requirements: Introduction to algebra with analythic geometry, Diferential and integral calculus I Entry competences: matrix, differential and integral calculus.						
Learning outcomes	Upon successful completion of this course students will be able to: - demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems - apply numerical methods to obtain approximate solutions to mathematical problems - derive numerical methods for various mathematical operations and tasks, such as interpolation, differentiation, integration, the solution of linear and nonlinear equations - analyse and evaluate the accuracy of common numerical methods.						
Syllabus	- Introduction: Preliminaries and error analysis (1) - Function evaluation; Horner's scheme. Complete Horner's scheme (1) - Solving linear systems; Gaussian elimination; LU factorization; LU factorization with pivoting (2) - Numerical properties of Gaussian elimination; Cholesky decomposition; Iteration methods (2) - Orthogonal polynomials and their properties (1) - Lagrange interpolation; Newton interpolation; Hermite interpolation (3) - Linear spline; Cubic spline (2) - Least squares approximation; Minimax approximation (4)						

	– Numerical integration: Newton–Cotes formulae; Midpoint rule; Trapezoidal rule; Simpson's rule; Romberg integration (2) – Gaussian quadrature (2) – Rootfinding for nonlinear equations: The bisection method; The secant method; Regula falsi (2) – Newton's method; Methods of higher order (2) – Fixed point iteration (2) – Numerical solutions of nonlinear systems of equations (2) – A chosen topic (2)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Attending classes. Working individually through exercises, in addition to group work during classes.

Monitoring student work

Class attendance	2	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums	2	Oral exam			
Written exam	1	Project			

Assessment and evaluation of student work	Two partial written exams / one final written exam and final oral exam. Written and oral exams are equally evaluated in the final grade.

Required literature

Title	Number of copies available	Availability on other medium
V. Hari at all, Numerička analiza, PMF, Zagreb, 2003., skripta		
M. Klaričić Bakula, Uvod u numeričku matematiku, PMFST, 2009., predavanja		
R. Scitovski, Numerička matematika, Odjel za matematiku Sveučilišta u Osijeku, 2004., skripta		

Supplementary literature	K. Atkinson, An Introduction to Numerical Analysis, John Wiley, New York, 1989. D. Kincaid and W. Cheney, Numerical Analysis, Brooks & Cole PC, Pacific Grove, 1990. R. Burden & J. D. Faires, Numerical Analysis, Brooks & Cole PC, Pacific Grove, 2011.

Quality assurance	Summary feedback for the whole class after the exam. Anonymous student survey.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="5">Introduction to Data Analysis</td></tr>
<tr><td>ID</td><td>PMP165</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Žarko Kovač</td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>20</td><td>0</td><td>30</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">– acquiring basic knowledge of measurement methods in environmental physics
– acquiring the basic skills needed to load and graphically display data
– train students to apply optimization methods for data processing and noise removal
– to train students for independent processing of time series
– to acquaint students with more advanced methods of processing time series</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">– basics of physics
– basics of mathematics
– basic programming</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Introductory knowledge of measurement methods in environmental physics.
2. Knowledge of reading and graphically displaying data.
3. Knowledge of linear and nonlinear regression.
4. Knowledge and the use of optimization methods in data processing.
5. Detection of trend and seasonal signal in a time series.
6. Usage of a moving mean as a filter.
7. Introductory theoretical knowledge and application of the Fourier transform.
8. Introductory theoretical knowledge and application of empirical orthogonal functions.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Sampling and measurement methods in environmental physics (1 hour of lectures and 2 hours of exercises)
2. Normal distribution (1 hour of lectures and 2 hours of exercises)
3. Least squares method (2 hours of lectures and 4 hours of exercises)
4. Linear regression (2 hours of lectures and 4 hours of exercises)
5. Nonlinear regression (2 hours of lectures and 4 hours of exercises)
6. Trend and seasonal signal (1 hour of lectures and 2 hours of exercises)
7. Moving mean (1 hour of lectures and 2 hours of exercises)
8. Fourier transform (2 hours of lectures and 4 hours of exercises)
9. Empirical orthogonal functions (3 hours of lectures and 6 hours of exercises)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars</td><td colspan="2">☐ Fieldwork
☑ Individual assignments</td><td colspan="3">☑ domaće zadaće</td></tr>
</table>

<table>
<tr><td rowspan="1"></td><td colspan="2">☑ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Attend at least 70% of lectures and 70% of exercises.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1.7</td><td>Research</td><td></td><td>Practical work</td><td>1.3</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>1</td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td>1</td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">During the first 7 weeks of classes, students receive 5 homework assignments from the first 5 teaching units. These assignments are handed over at the end of the 8th week of classes. During the next 7 weeks of classes, students receive 5 new homework assignments from the last 4 teaching units. These assignments are handed over at the end of the 15th week of class. Students who submit assignments on time and achieve more than 50% of the possible points are exempted from writing the written part of the exam. Students who do not pass assignments or achieve less than 50% of the possible points must take a written exam. In the 8th week of classes, students are given a project assignment that they must submit by the end of the semester. The final grade is formed on the basis of homework / exam (1/3 of the grade), project assignment (1/3) and answers to the oral exam (1/3) of the grade.</td></tr>
<tr><td rowspan="2">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">William Menke, Joshua Menke Environmental Data Analysis with MATLAB Elsevier, 2016</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Zhihua Zhang: Environmental data analysis: Methods and applications, Walter de Gruyter, 2017.
David M. Glover, William J. Jenkins, Scott C Dooney: Modelling methods for marine science, Cambridge University Press, 2011.</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Exam results statistics and student evaluation through an anonymous survey at the end of the course. The survey is conducted according to the regulations of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

Subject name	Introduction to Applied Mathematics						
ID	PMM701	Study year	2.				
Lecturer	doc. dr. sc. Andrijana Ćurković	Points value (ECTS)	5.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	0	30	0	
Subject status	Compulsory	Online percentage	40%				
Subject description							
Subject goals	Demonstrate examples of real life problem that can be modeled by differential equations and / or solved by numerical methods. Explore the use of differential and integral calculus to solve ordinary differential equations and simple numerical problems.						
Enrolment requirements	The student must have passed the following courses: Introduction to Mathematical Analysis, Mathematical Analysis I. The student must have taken the following course: Mathematical Analysis II.						
Learning outcomes	After completing the course, students are expected to: identify real-life problems that can be modeled by differential equations and/or solved using numerical methods; distinguish the characteristic properties of linear equation from nonlinear ones; select and apply appropriate methods to solve basic differential equations; explain the reasons, advantages and disadvantages of using numerical methods; apply basic numerical methods for solving nonlinear equations; explain ideas and apply methods to solve interpolation problems						
Syllabus	Introduction: Ordinary Differential Equations, Motivation (1) First Order Ordinary Differential Equations: Existence and Uniqueness of Solution. Different types of First Order Equations (including ODE with separable variables, homogeneous, Bernoulli, exact) (3) Higher Order Linear Differential Equations: Homogeneous Linear Equations. Wronskian. Nonhomogeneous Equations (Undetermined Coefficients, Variation of Parameters) (3) Approximation theory, Motivation, Error analysis (1)						

	Numerical methods for solving nonlinear equations: Bisection method, Newton's method, Fixed point iteration method (1) Basic idea of interpolation, Lagrange and Newton form of interpolating polynomial, Linear and cubic spline (3) Basic idea of numerical integration (1) Numerical methods for differential equations: basic concept (1)						
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐		
Student obligations	Attend class regularly and take notes. Take exams when scheduled.						
Monitoring student work	Class attendance	2	Research		Practical work		
	Experimental work		Paper				
	Essay		Seminar paper				
	Colloquiums		Oral exam	1			
	Written exam	2	Project				
Assessment and evaluation of student work	The final exam consists of a written and an oral part. Successful written exam is required for taking the oral exam. Acceptable results achieved in midterm exams taken during the semester replace the written part of the exam.						

Required literature	Title	Number of copies available	Availability on other medium
	W.E. Boyce and R.C. DiPrima, Elementary Differential Equations and Boundary Value Problems, John Wiley & Sons, Inc., New York, 2012.		
	R. Scitovski, Numerička matematika, Odjel za matematiku, Sveučilište u Osijeku, 2004.		

Supplementary literature	M. Alić, Obične diferencijalne jednadžbe, skripta, PMF, Zagreb, Matematički odjel, 1994. V. Hari i dr, Numerička analiza, skripta PMF, Zagreb, Matematički odjel, 2004.

	K. Atkinson, An Introduction to Numerical Analysis, John Wiley, New York, 1989.
Quality assurance	Student evaluations following completion of the course. The evaluations are administered according to the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Introduction to Number Theory</td></tr>
<tr><td>ID</td><td>PMM102</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Borka Jadrijević</td><td>Points value (ECTS)</td><td>5.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td><table><tr><td>L</td><td>S</td><td>E</td><td>P</td></tr><tr><td>30</td><td>0</td><td>30</td><td>0</td></tr></table></td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>30%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Students will acquire basic knowledge in elementary number theory and the ability to apply that knowledge in solving various problems related to these topics. The course is a good background for understanding and learning more advanced courses in this area.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Upon successful completion of the course, the student is able to: – define and interpret the fundamental concepts of divisibility and apply them to solve a variety of problems; – formulate and prove basic results of modular arithmetic; – perform calculations using modular arithmetic; – solve congruences and system of congruences of various types; – prove basic results about quadratic residues and use the Quadratic Reciprocity Law to calculate the Legendre symbols; – describe important multiplicative functions in number theory; – formulate basic concepts of binary quadratic forms; – describe and use formulas for generating the Pythagorean triples; – define continued fraction expansion, compute continued fraction expansion for rationals and quadratic irrationals and apply it to solving the Pell equation.</td></tr>
<tr><td>Syllabus</td><td colspan="3">1. Divisibility. Greatest common divisor. Euclidean algorithm. Linear Diophantine equations. Primes. Unique factorization. (3 hours)
2. Congruences. Linear congruences. Chinese remainder theorem. Euler's theorem. Wilson's theorem. Hensel's lemma. Primitive roots and indices. (9 hours)
3. Quadratic residues. Legendre symbol. Quadratic reciprocity law. Jacobi symbol. (4 hours)
4. Quadratic forms. Equivalence and reduction of binary quadratic forms. Sums of two and four squares. (3 hours)
5. Arithmetic functions. Number and sum of positive divisors functions. Euler and Möbius functions, Distribution of primes. Asymptotic estimates for arithmetic functions. (4 hours)
6. Diophantine approximation and Diophantine equations. Dirichlet's theorem. Continued fractions. Diophantine approximation. Pell equation. Pythagorean triples. (7 hours)</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☐ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Attendance of lectures and tutorial sessions is obligatory.</td></tr>
</table>

<table>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>2.5</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>1.5</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">The exam is taken in written and oral form. The passing grade of the written exam is a requirement for the oral exam. Both parts of the exam are equally weighted in the final grade. There are two partial written exams during the semester. Passing both partial written exams allows students to take the oral exam. In case of failure of the partial exams or the oral exam, the student must retake the written exam before taking the oral exam again.</td></tr>
<tr><td rowspan="5">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">A.Dujella, Uvod u teoriju brojeva, skripta PMF-MO, Zagreb http://web.math.hr/~duje/utb.html;</td><td></td><td></td></tr>
<tr><td colspan="4">I. Niven,H. S. Zuckerman, H. L. Montgomery, An Introduction to the Theory Numbers, Wiley, New York, 1991;</td><td></td><td></td></tr>
<tr><td colspan="4">K. H. Rosen, Elementary Number Theory and Its Applications, Addison-Wesley, Reading, 1993.;</td><td></td><td></td></tr>
<tr><td colspan="4">M. Bombardelli, A. Dujella, S.Slijepčević, Matematička natjecanja učenika srednjih škola, HMD, Element, Zagreb, 1996;</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">H. A. Baker: A Concise Introduction to the Theory of Numbers, Cambridge University Press, Cambridge, 1994. H. E. Rose, A Course in Number Theory, Oxford University Press, Oxford, 1995;</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Statistics of test results and anonymous student evaluations at the end of the semester according to the regulations of the University of Split.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

Subject name	Introduction to topology						
ID	PMM114	Study year	3.				
Lecturer	izv. prof. dr. sc. Goran Erceg	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	0	30	0	
Subject status	Elective	Online percentage	30%				
Subject description							
Subject goals	The course objective is to introduce students with fundamental concepts and methods in general topology. This gives the basics for more advanced studies in analysis, topolgy and geometry as well as courses building on these topics.						
Enrolment requirements	Successfully completed course: Set theory						
Learning outcomes	It is expected that a student will - understand fundamental concepts and methods in general topology - be able to state and prove standard results regarding (compact, connected) topological spaces and continuous functions - be able to apply the theory in the course to reason about concrete topological spaces and their properties - be able to decide whether a simple statement about topological spaces and continuous functions is true, providing a proof or counterexample as appropriate - develop critical and analytical thinking and demonstrate skills in communicating mathematics orally and in writing						
Syllabus	- Basic notions (6 hours) Topological space. Basis and subbasis. The second countable space. Metric topology. Closed sets. Interior, closure and boundary of a set. Neighbourhoods. Local base. The first countable space. Derived set. Density. Separability. Subspace. Product space. Quotient space. - Separation axioms (2 hours) T1-spaces. Hausdorff spaces. Regular spaces. Normal spaces. - Convergence (6 hours)						

	Limit of a sequence. Accumulation point of a sequence. Pointwise and uniform convergence. Convergence of nets. - Continuity (6 hours) Continuous functions. Characterization of continuous functions. Homeomorphism. Embedding. Urysohn characterization of normal spaces. Tietze extension theorem. - Connectedness (6 hours) Connected space. Characterization of connected spaces. Pathwise connected space. Components and path-components. Product of (pathwise) connected spaces. Locally (pathwise) connected space. - Compactness (6 hours) Compact space. Characterization of compact spaces. Compact metric spaces. Product of compact spaces. Continuous functions on compact spaces. Dini's theorem. Locally compact space. Compactification
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Attendance at lectures and exercises, written assignments, self-study using required and optional literature

Monitoring student work:

Class attendance	0.5	Research		Practical work	
Experimental work		Paper		Ispit	5.5
Essay		Seminar paper			
Colloquiums		Oral exam			
Written exam		Project			

Assessment and evaluation of student work	The exam consists of written and oral part. The oral part comes after positively graded (at least 50%) written part Both parts of the exam are equally evaluated in the final grade.

Required literature:

Title	Number of copies available	Availability on other medium
J. Munkres, Topology, Pearson Education International, New York, 2000		da

	S. Mardešić, Matematička analiza u n-dimenzionalnom realnom prostoru I, Školska knjiga, Zagreb, 1974.		
	J. Dugundji, Topology, Allyn and Bacon Inc. Boston, 1966		
Supplementary literature	R. Engelking, General Topology, PNW, Warszawa, 1977.		
Quality assurance	Exam statistics and students' quality evaluation through anonymous poles		
Other (in the opinion of the proponent)			

Subject name	Introduction to Artificial Intelligence						
ID	PMII10	Study year	1.				
Lecturer	prof. dr. sc. Saša Mladenović	Points value (ECTS)	5.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	0	30	0	
Subject status	Compulsory	Online percentage	25%				
Subject description							
Subject goals	Artificial Intelligence (AI) is devoted to the computational study of intelligent behavior. The element that the fields of AI have in common is the creation of agents/machines that can "think". This course will cover a broad introduction to the techniques that enable agents/computers to behave intelligently: problem solving, representing knowledge, reasoning, learning, perceiving, and interpreting. The bulk of this course reflects this diversity. We will examine the fundamental questions and issues of AI and will explore the essential techniques. The course is project oriented, with programming assignments spread throughout the semester using the LISP based NetLogo programming environment and Prolog programming language.						
Enrolment requirements	None.						
Learning outcomes	Upon successful completion of this course, the student will be able to: 1. To understand the modern view of AI as the study of agents that receive percepts from the environment and perform actions 2. Describe the major applications, topics, and research areas of artificial intelligence (AI), including search, machine learning, knowledge representation and inference, natural language processing, vision, and robotics. 3. Apply basic techniques of AI in computational solutions to problems. 4. Discuss the role of AI research areas in growing the understanding of human intelligence. 5. Identify the boundaries of the capabilities of current AI systems.						
Syllabus	1. Introduction to concept of intelligence (2h) 2. Multiple types of intelligence (2h) 3. Intelligent Agents and environments (2h) 4. Problem Solving by Search (2h) 5. Uninformed Search algorithms (4h) 6. Informed Search algorithms (2h) 7. Midterm 8. Artificial Neural Networks (2h) 9. Multiagent systems (2h) 10. Knowledge representation (2h) 11. Genetic algorithms (2h) 12. Special Topics: Learning, Robots in education (2h)						

<table>
<tr><td></td><td colspan="6">13. Practical examples of artificial intelligence usage (2h)
14. Artificial intelligence and ethical problems (2h)
15. Project (2h)
Laboratory exercises match lecture topics and schedule.</td></tr>
<tr><td>Teaching types</td><td colspan="6">☑ Lectures
☐ Seminars
☐ Exercises
☐ Fully online
☑ Combined online
☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☑ Laboratory
☐ Mentoring
☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Lecture and laboratory attendance, active participation in course activities, homework and project realization, final exam.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1</td><td>Research</td><td>0.5</td><td>Practical work</td><td>1</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td>0.5</td><td>Oral exam</td><td>0.5</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>0.5</td><td>Project</td><td>1</td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Attendance/Participation (20%)
Midterm / Project (40%)
Final/Oral Exam (40%)</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Artificial Intelligence: A Modern Approach. Stuart Russell and Peter Norvig Prentice Hall, 2009 ISBN:0136042597 9780136042594</td><td></td><td></td></tr>
<tr><td colspan="4">Lecture notes: Uvod u umjetnu inteligenciju, Saša Mladenović, Goran Zaharija</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Online Student material, including solutions to selected problems and additional reading</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Student discussion, anonymous student evaluation questionnaire, student success rate, self-assessment</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="6">INTRODUCTION OF PROBABILITY</td></tr>
<tr><td>ID</td><td>PMM716</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Snježana Braić</td><td>Points value (ECTS)</td><td colspan="4">8.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>45</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Main course objective is to get students acquainted with basic ideas, results and methods of probability theory and mathematical statistics. Students will:

be introduced to concepts of probability space and analyse its properties

learn basic examples of probability spaces

acquire basic knowledges about conditional probability and analyse its properties

acquire basic knowledges about random variables and their probability density and distribution functions

learn Chebyshev inequality, law of large numbers and central limit theorem

learn to compute numerical characteristics of random variables

be introduced with the basics of mathematical statistics</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Course enrolment:

successfully completed course Differential and integral calculus I

successfully completed course Combinatorics

taken courses Mathematical analysis in Rn I and II, or Differential and integral calculus II</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon successful completion of this course students will be able to:

define probability space and describe its properties

describe basic examples of probability spaces</td></tr>
</table>

	distinguish and describe probability models define conditional probability and analyse its properties apply probability properties and combinatorial methods in solving probability problems define discrete and continuous random variables and their probability density and distribution functions define, compute and analyse numerical characteristics of discrete random variables state, prove and apply theorems of probability theory define random sample and statistics, describe estimators and calculate confidence intervals
Syllabus	Sample space, probability space (3) Discrete probability space– definition and properties (3) Conditional probability, independent events (4) Bernoulli trials (2) Discrete random variables and their distribution (3) Density function and distribution function of discrete random variable (3) Numerical characteristics of discrete random variables (6) Chebyshev inequality, law of large numbers and central limit theorem (3) Random vectors, probability generating functions (4) Measure spaces (2) Continuous random variables, density function and distribution function (4) Mathematical expectation and variance of continuous random variables (3)

	Random sample, statistics, estimators and confidence intervals (5) Matematičko očekivanje i varijanca neprekidnih slučajnih varijabli (3) Slučajni uzorci, statistike, procjenitelji, pouzdani intervali (5)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Attendance.

Monitoring student work						
Class attendance	2	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums	3	Oral exam	3		
Written exam		Project			

Assessment and evaluation of student work	The exam which requires solving practical and theoretical problems is taken in written form and is followed by an oral theoretical exam. A passed written exam is a prerequisite for the oral exam. The written exam can be taken partially, in three parts, during class.

Required literature

Title	Number of copies available	Availability on other medium
S. Braić, V. Gotovac, I. Ugrina, Uvod u vjerojatnost i statistiku, skripta PMF-a u Splitu		
N. Sarapa, Teorija vjerojatnosti, Školska knjiga, Zagreb, 2002..		
N. Sarapa, Vjerojatnost i statistika I i II, Školska knjiga, Zagreb, 1993..		

Supplementary literature	1. W. Feller, An Introduction to Probability Theory and Its Application, J.Wiley, New York, 1966. 2. I. Sošić, Primijenjena statistika, Školska knjiga, Zagreb, 2004. 3. T. Pogany, Teorija vjerojatnosti, zbirka riješenih ispitnih zadataka, Sveučilište u Rijeci, Odjel za pomorstvo, Rijeka, 1999. 4. M. Spiegel, J. Schiller, R. A. Srinivasan, Probability and Statistics, Schaum's outline series, McGraw-Hill Book

	Company, New York, 2000.
Quality assurance	Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.
Other (in the opinion of the proponent)	

Subject name	Waves and Optics		
ID	PMP006	Study year	2.
Lecturer	doc. dr. sc. Toni Šćulac	Points value (ECTS)	9.0
Associates		Class execution (number of hours in semester)	L: 60, S: 15, E: 30, P: 0
Subject status	Compulsory	Online percentage	0%
Subject description			
Subject goals	Allow understanding and application of physics terms and laws of oscillations, waves, and optics with the goal of solving problems, explening natural phenomena and how different instruments work.		
Enrolment requirements	Mehanics (passed)		
Learning outcomes	1. Derive and use equation for mechanical and electromagnetic oscilatory systems that transfer energy, discuss the limits of the equation its starting conditions and boundry conditions 2. Define and anlyse normal modes of oscillations for two or more systems that are connected 3. Derive and use the wave equation for different mechanical and electromagnetic systems, discuss the limits of the equation its starting conditions and boundry conditions 4. Analyse and explain superposition of two or more wave sources, difraction, and interference and conditions needed for them to occure 5. Analyse wave propagation in different media, discuss dispersion nad group and phase velocity of waves 6. Discuss and use concepts and laws of geometrical optic to describe and explain optical instruments, their usage and limitations 7. Discuss main experiments of the wave nature of light 8. Critically discuss application of the laws of oscillations, waves, and optics in eveyday life 9. Use analitical and numerical methods to solve problems for mechanical and electromagnetic oscillations, waves, and optics		
Syllabus	1. OScillations. Simple harmonic oscillator. Damping. Forced oscillations. (4 + 1 + 2 hours) 2. Addition of harmonic oscillators. (4 + 1 + 2 hours) 3. Transversal and longitudinal waves. Wave equation. (4 + 1 + 2 hours) 4. Velocity of transversal waves. Energy and power of the wave. Wave packet.(4 + 1 + 2 hours) 5. Interferention. Standing waves. Reflection. Standing waves. Resonance. (4 + 1 + 2 hours) 6. Fourier analysis. (4 + 1 + 2 hours) 7. Sound waves. Doppler effect. (4 + 1 + 2 hours) 8. Waves in solid state medium. (4 + 1 + 2 hours) 9. Electromagnetic oscillations. (4 + 1 + 2 hours) 10. Polarisation and dispersion. (4 + 1 + 2 hours) 11. Optics, mirrors, and lenses. (4 + 1 + 2 hours)		

	12. Wave optics. Interferention. Difraction. (4 + 1 + 2 hours) 13. Optical instruments (4 + 1 + 2 hours) 14. Spectral analysis. Lasers. (4 + 1 + 2 hours) 15. Dual properties of particles and waves. (4 + 1 + 2 hours)						
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring			☐ ☐ ☐ ☐	
Student obligations	1. Active participation during classes with critical judgment and argumented opinion, questions, and answers to questions 2. Solving given problems 3. Critical discussions						
Monitoring student work	Class attendance	3.5	Research		Practical work		
	Experimental work		Paper		Problem solving	1	
	Essay		Seminar paper				
	Colloquiums		Oral exam	2.5			
	Written exam	2	Project				
Assessment and evaluation of student work	Solutions of problems from exercises will be graded together with the oral exam.						
Required literature	Title				Number of copies available	Availability on other medium	
	Halliday, Resnick, Walker: Fundamentals of Physics, John Wiley & Sons, 2003.				6	yes	
	Mile Dželalija, slides from lectures, 2015.					yes (free access)	
Supplementary literature	– F.S. Crawford. Waves. Berkeley Physics Course III, McGraww-Hill, New York – Babić, R. Krsnik i M. Očko, Zbirka riješenih zadataka iz fizike. Školska knjiga, Zagreb 1982. – F.W. Sears, M.W. Zemansky, H. D.Young, R. A. Freedman. University Physics. Addison Wesley London, 2000. – R.P. Feynman, R.B. Leighton, M. Sands. The Feynman lectures on physics I, Addison-Wesley, London 1975. – M. Paić, Osnove fizike I,IV, Liber, Zagreb, 1978-1983.						
Quality assurance	1. Lecturers who have subjects with correlated learning outcomes work together to ensure quality of learning. 2. Statistics of test scores and assessment of performance in accordance with established learning outcomes.						

	3. Evaluation of students through an anonymous survey conducted in accordance with the regulations of the University of Split.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Vector spaces I</td></tr>
<tr><td>ID</td><td>PMM201</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Gordan Radobolja</td><td>Points value (ECTS)</td><td>6.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 30, S: 0, E: 30, P: 0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>30%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Deepen knowledge on vector spaces and linear operators

Introduce Jordan form

Define operator functions

Introduce inner product spaces and typical operators on them</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Courses passed: Introduction to algebra with analythic geometry, Linear algebra</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Students will be able to:

analyze finite and infinite dimensional vector spaces and their properties, including the basis structure of vector spaces;

give examples of fundamental notions and constructions in three dimensional Euclidean space;

use the definition and properties of linear transformations and matrices of linear transformations and change of basis, including kernel, range and isomorphism;

compute with the characteristic and minimal polynomial, eigenvalues and eigenspaces, find the geometric and algebraic multiplicities of an eigenvalue

use methods from complex analysis in defining and calculate with operator function;

compute inner products and determine orthogonality on vector spaces, including Gram-Schmidt orthogonalization.</td></tr>
<tr><td>Syllabus</td><td colspan="3">Finite dimensional vector spaces (4)

Linear operators and their matrices (4)</td></tr>
</table>

	Dual space and dual operator (2) Algebras and homomorphisms (1) Minimal polynomial and spectrum (2) Invariant subspaces (1) Nilpotent operators (2) Jordan normal form of a linear operator (2) Convergence in an operator spaces (1) Operator functions (4) Inner product spaces and norm (4) Operators on inner product spaces (3)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☑ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Student responsibilities Lectures and exercises attendances are obligatory.

Monitoring student work

Class attendance	2	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums	3	Oral exam	1		
Written exam		Project			

Assessment and evaluation of student work	– 4 tests (10 pts each) – 2 partial exams (25 pts each) – final exam (10 pts)

	Marks distribution 60 – 70 (2) 71 – 80 (3) 81 – 90 (4) 91 – 100 (5)		
Required literature	Title	Number of copies available	Availability on other medium
	H. Kraljević, Vektorski prostori, skripta, Sveučilište u Osijeku, 2008.		
	S. Kurepa, Konačno dimenzionalni vektorski prostori i primjene, Liber, Zagreb, 1992.		
	J. S. Golan, The Linear Algebra a Beginning Graduate Student Ought to Know, Kluwer, 2004.		
Supplementary literature	P. R. Halmos, Finite Dimensional Vector Spaces, Van Nostrand, New York, 1958. S. Lang, Linear algebra, Addiseon-Wesley, Reading, 1973. K. Horvatić, Linearna algebra, PMF – Matematički odjel, HMD, Zagreb, 1995.		
Quality assurance	Discussion in classes and official student survey.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Vector spaces II</td></tr>
<tr><td>ID</td><td>PMM603</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Gordan Radobolja</td><td>Points value (ECTS)</td><td colspan="4">6.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>45</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">30%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">The aim of the course is to acquaint students with various concepts of the theory of vector spaces. The emphasis is on the construction of a variety of mathematical structures using bilinear forms and tensor products. Also, tensor products will be used to construct algebras and bilinear forms will be associated with groups.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Requirements: Course passed: Vector Spaces I.
Required competences: basic knowledge of mathematical structures.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Student is able to:
-define bilinear and quadratic forms
-explain different tensor products
-apply tensor products on construction of algebras
-analyse set of all invertible linear operators that preserve given bilinear, hermitian or quadratic form</td></tr>
<tr><td>Syllabus</td><td colspan="6">-Dual vector space (2)
-Bilinear forms (2)
-Symmetric forms (2)
- Quadratic forms (2)
-Alternating i skew-symetric forms (2)
-Hermitian forms (2)
-Tensor product (3)
-Symmetric product (2)
-Exterior product (2)
-Basic properties of algebras (2)
-Tensor algebra (2)
-Symmetric algebra (2)
-Exterior algebra (2)
- Clifford algebras (2)
-Lie algebras (2)
-Nonassociative algebras (2)
-Linear groups (2)
-General linear group (2)</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">–Symplectic groups (2)
–Unitary groups (2)
–Orthogonal groups (2)
–Matrix Lie groups (2)</td></tr>
<tr><td>Teaching types</td><td colspan="2">☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="3">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Attending classes and writing seminar paper</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>1.5</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>3.5</td><td></td><td></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td>1</td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">Students present seminars and solve practical problems during semester. Grade is decided after the final exam which can be written or oral.</td></tr>
<tr><td rowspan="2">Required literature</td><td>Title</td><td colspan="2">Number of copies available</td><td colspan="3">Availability on other medium</td></tr>
<tr><td colspan="6">–</td></tr>
<tr><td>Supplementary literature</td><td colspan="6">1.M.Artin, Algebra, Prentice Hall,1991.

2. S. Lang, Algebra, Springer,2002.

3.P.A.Grillet, Abstract algebra, Springer,2007.

4.A.W.Knapp, Basic algebra, Cornerstones, 2006.

5.S. Kurepa, Konačno dimenzionalni vektorski prostori i primjene, Liber, Zagreb, 1992.

6.K. Horvatić, Linearna algebra, skripta, Zagreb, 1992</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Statistics of test results and student evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="3">Probability I</td></tr>
<tr><td>ID</td><td>PMM228</td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Vesna Gotovac Đogaš</td><td>Points value (ECTS)</td><td>6.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L S E P
30 0 30 0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td>30%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">Course objective is stating and proving main results from classical probability theory using measure theory.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Course enrolment requirement: Completed course Introduction to probability and statistic. Course taken: Measure and integral

Entry competences required: Basic knowledge of measure theory and Lebesgue integration.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">At the end of this course, students should be able to:

Understand and apply probability theory concepts and methods

Use multidimensional distributions and analyze their properties

Solve problems regarding sums and sequences of random variables using characteristic functions

Differentiate between different types of convergence of random variables

Recognize conditions for applying laws of large numbers and central limit theorems</td></tr>
<tr><td>Syllabus</td><td colspan="3">Random variables. (2)

Cumulative distribution function of random variables. Classification of random variables. (2)

Cumulative distribution function of random vectors. Classification of random vectors. (2)

Probability on infinite dimensional spaces. (2)

Mathematical expectation as Lebesgue integral. Properties of mathematical expectation. Radon-Nikodym theorem (without proof). Transformation of mathematical expectation. Variance. Important inequalities. L^p spaces. (2)</td></tr>
</table>

	Types of convergence of random variables. (2) Integration on product spaces. (2) Independent random variables - different characterizations. Functions of random variables and random vectors. Applications in statistics. (4) Weak law of large numbers (2) Strong law of large numbers. (2) Characteristic functions (2-4) Central limit theorem (2-4)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Students are obliged to regularly attend lectures and exercises.

Monitoring student work

Class attendance	2	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam	2		
Written exam	2	Project			

Assessment and evaluation of student work	There are 2 mid-term exams during a semester. Passing both mid-term exams enables students to take an oral exam. Successfully passing the oral exam leads to successful completion of the course. Final grade is derived as the arithmetic mean of scores in mid-term exams (or a written exam) and the oral exam. In the case of failure in mid-term exams or the oral exam students must undergo a written exam before approaching oral exam again.

Required literature

Title	Number of copies available	Availability on other medium
N. Sarapa, Teorija vjerojatnosti, Školska knjiga, Zagreb, 2002.		

Supplementary literature	R. B. Ash, Real Analysis and Probability, Academic Press, New York, 1972. M. M. Rao, Probability Theory with Applications, Academic Press, New York, 1984. R. Durret, Probability: Theory and Examples, Wads
Quality assurance	Detailed statistics of student results, gathering feedback from students through official questionnaires and lecturer's self-evaluation.
Other (in the opinion of the proponent)	

Subject name	ASSESSMENT IN EDUCATION		
ID	PMM809	Study year	2.
Lecturer	Željka Zorić, v. pred.	Points value (ECTS)	3.0
Associates		Class execution (number of hours in semester)	L: 0, S: 30, E: 0, P: 0
Subject status	Elective	Online percentage	0%
Subject description			
Subject goals	Enable students to systematically and effectively evaluate pupils in math education Enable students for the evaluation of their own performance Enable students to objectively and critically interpret results obtained through various models of evaluation of pupils' achievements in maths		
Enrolment requirements	No prerequisites for the course.		
Learning outcomes	After completing the course, the students should be able to do the following: Set clear mathematics learning goals in accordance with the official curriculum and taxonomy standards Distinguish between the types of assessment in education Define objective criteria of assessment and evaluation of learning outcomes Apply various corresponding approaches and methods of learning results assessment and explain the reasoning behind Independently design and assess written and oral tests in accordance with the criteria set in advance Document pupil's participation and contribution in various learning activities of math related contents Provide concrete and effective feedback to pupils and parents on pupil's performance, progress and achieved success Assess the learning results by assessment of results of pupils' performance Analyse results obtained by assessment in order to increase the quality of learning and teaching a		

Syllabus	Objectives of math education and outcomes of math learning. Math concepts and processes. Knowledge taxonomies. Designing of measurable math learning outcomes. Assessment of pupils' and teachers' performance (internal, external, diagnostic, formative and summative, criteria-based, teacher self-assessment) Assessment as a part of the learning and teaching processes (assessment as learning, assessment for learning and assessment of learning) Methods of monitoring and assessment of pupils' performance in math. Measurement of the level of achievement of set objectives and results. Criteria-based assessment Methods of monitoring and assessment of pupils' performance in math. Note taking. Self-assessment and peer assessment Designing a math task in order to measure the set learning outcomes. Types of math tasks. Designing of written and oral tests in order to measure the set learning outcomes. Standardised test. External assessment Formative and summative assessment. Evaluation. Feedback provided to pupils and parents.

Teaching types			
	☐ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring	☑ Radionice ☐ ☐ ☐

Student obligations	Students are obliged to attend the class, to actively participate in all types of educational programs, to submit and present their seminar papers and to pass the final evaluation

Monitoring student work						
	Class attendance	0.8	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	1.4		
	Colloquiums		Oral exam	0.8		
	Written exam		Project			

Assessment and evaluation	Students attending the course regularly (over 90% of the class), who received a positive evaluation for writing and

of student work	presenting of their seminar paper are entitled to a signature. Students entitled to a signature are evaluated based on the grades on the seminar paper (65%) and the final exam (35%). Seminar paper Seminar paper comprises the actual written work and the presentation. It accounts for 65% of the total grade. Final exam Final exam can be administered either in writing or orally, during the regular exam periods. All students getting the passing grade on the seminar paper are allowed to take the final exam. The final exam is considered as passed if a student earns one of the passing grades.a.		
Required literature	Title	Number of copies available	Availability on other medium
	C.R.Tobey, P. D. Keeley, Mathematics Formative assessment: 75 practical strategies for linking assessment, instruction and learning, Corwin Pr Inc, 2011.		
	E. Depka, Designing assessment for mathematics		
	N.E.Gronlund, Assessment of student achievement		
	J.H. McMillan, Classroom assessment: principles and practice for effective instruction		
	W. J. Popham, Classroom assessment: What teachers need to know		
Supplementary literature	M. Niss, Investigations into assessment in mathematics education: an ICMI Study,2nd reprint, Springer, 2010 Miller-Linn-Gronlund, Mesurement and assessment in teaching, 10th edition, Pearson Education Inc, 2009 J. Dodge, 25 quick formative assessments for differentiated classroom, Scholastic Inc, 2009 Driscoll-Wood, Developing outcomes based assessment for learner-centered education, Stylus Publishing, 2007.		

	W. J. Popham, Transformative assessment, ASCD, 2008. C. Walker, E. Schmidt, Smart tests, Pembroke Publishers Limited, 2004
Quality assurance	In the final week of this course an anonymous survey will take place in order for students to evaluate the quality of the class. At the end of each semester an analysis of students' success at the test (trial) teaching lessons in the relevant semester. tru.
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Undergraduate Thesis</td></tr>
<tr><td>ID</td><td>PMPBSC</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td></td><td>Points value (ECTS)</td><td colspan="4">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td>P</td></tr>
<tr><td>0</td><td>15</td><td>0</td><td>0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="4">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">To prepare students for independent work, written and oral presentations in physics, thereby training them for further independent and interdisciplinary study of physics with other fields.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Compulsory subject of the last year of study. The defense is approached when all other subjects have been passed.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Formulate the goals and tasks of professional work.
2. Analyze professional and scientific literature.
3. Organize and use acquired knowledge to describe the chosen topic.
4. Apply the scientific method.
5. Correctly use measurement units, mathematical apparatus and professional terminology.
6. Edit the text stylistically with the application of spelling and grammar rules of the standard language in spoken and written communication.
7. Use multiple representations of data and concepts (tables, graphs of functions, graphs, diagrams, drawings, photographs, schemes, pictures) and properly cite the literature.
8. Present the problem, its analysis of the results in the form of an oral presentation and in the form of a text in the form of a professional or scientific paper.
9. Create a correct, linguistically and terminologically consistent and consistent paper, in accordance with the standards of the profession, which deals with the chosen topic in an original way, i.e. in which the results of the study of the chosen topic are presented clearly and precisely.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Under the guidance of a mentor, students carry out all activities themselves, from designing the work to preparing the written work and presentation.</td></tr>
<tr><td>Teaching types</td><td>☐ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="2">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☑ Mentoring</td><td colspan="3">☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Independent preparation of the work, implementation and presentation.</td></tr>
<tr><td>Monitoring student work</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
</table>

	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project	5		
Assessment and evaluation of student work	Written thesis and presentation.					
Required literature	Title	Number of copies available	Availability on other medium			
	–					
Supplementary literature	Available literature on the selected topic.					
Quality assurance	1. Conversations with the student, before and after graduation. 2. Student surveys.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="7">Undergraduate Thesis</td></tr>
<tr><td>ID</td><td>PMPBSC</td><td>Study year</td><td colspan="5">3.</td></tr>
<tr><td>Lecturer</td><td></td><td>Points value (ECTS)</td><td colspan="5">3.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td rowspan="2">Class execution (number of hours in semester)</td><td>L</td><td>S</td><td>E</td><td colspan="2">P</td></tr>
<tr><td>0</td><td>15</td><td>0</td><td colspan="2">0</td></tr>
<tr><td>Subject status</td><td>Compulsory</td><td>Online percentage</td><td colspan="5">0%</td></tr>
<tr><td colspan="8">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="7">To prepare students for independent work, written and oral presentations in physics, thereby training them for further independent and interdisciplinary study of physics with other fields.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="7">Compulsory subject of the last year of study. The defense is approached when all other subjects have been passed.</td></tr>
<tr><td>Learning outcomes</td><td colspan="7">1. Organize research or review work in accordance with modern procedures.
2. Elaborate the idea of the final paper, and choose the appropriate professional literature.
3. Carry out measurements and/or collect data and properly interpret and record them.
4. Create a complete written form of work, including previous analysis and data visualization.
5. Present the final paper.</td></tr>
<tr><td>Syllabus</td><td colspan="7">Under the guidance of a mentor, students carry out all activities themselves, from designing the work to preparing the written work and presentation.</td></tr>
<tr><td>Teaching types</td><td>☐ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td colspan="4">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☑ Mentoring</td><td colspan="2">☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="7">Independent preparation of the work, implementation and presentation.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td></td><td>Research</td><td></td><td>Practical work</td><td colspan="2"></td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Colloquiums</td><td></td><td>Oral exam</td><td></td><td></td><td colspan="2"></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td>3</td><td></td><td colspan="2"></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="7">Written thesis and presentation.</td></tr>
<tr><td>Required literature</td><td>Title</td><td colspan="3">Number of copies available</td><td colspan="3">Availability on other medium</td></tr>
</table>

	–
Supplementary literature	Available literature on the selected topic.
Quality assurance	1. Conversations with the student, before and after graduation. 2. Student surveys.
Other (in the opinion of the proponent)	