PRIRODOSLOVNO-MATEMATIČKI FAKULTET U SPLITU

Erasmus catalogue
2025./2026.

	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	1 5 3	Graduate Undergraduate	Physics and Computer Science, specialization in Education; Computer Science; Physics (specialization in Education); Physics (specialization in Computational Physics); Computer Science and Technics, specialization in Education; Mathematics and Computer Science, specialization in Education
2.	PMIK25 230831	Analitika učenja	Learning Analytics in Computer Based Education	30+0+30+0	5	2	Graduate	Data science and engineering
3.	PMM502 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)
4.	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)
5.	PMII15 211924	Arhitekture neuronskih mreža	Neural Network Architectures	30+0+30+0	5	3	Graduate	Data science and engineering; Computer Science, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Computer Science); Mathematics (specialization in Statistics and Computer Science)
6.	PMP133 267599	Astročestična fizika	Astroparticle Physics	30+0+15+0	6	3	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics);

								Physics (specialization in Computational Physics)
7.	PMP16D 173831	Atmosfersko onečišćenje	Atmospheric pollution	30+0+15+0	4	2	Graduate	Physics (specialization in Biophysics); Physics (specialization in Environmental Physics)
8.	PMIH10 79286	Baze podataka	Databases	30+0+30+0	5	3 5 1	Graduate Undergraduate	Engineering Physics (specialization in Thermodynamic Systems); Engineering Physics (specialization in Mechanical Systems); Mathematics (staro); Mathematics and Computer Science (staro); Computer Science; Computer Science and Technics; Physics; Physics (specialization in Computational Physics); Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Statistics and Computer Science); Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science)
9.	PMP141 267582	Biofizika	Biophysics	45+15+30+0	6	1 3	Graduate	Physics and Computer Science, specialization in Education; Physics (specialization in Education); Physics (specialization in Biophysics); Physics (specialization in Computational Physics)
10.	PMP247 267667	Biofizika slušanja i govora	Biophysics of Hearing and Speech	35+5+10+0	5	2	Graduate	Physics (specialization in Biophysics)

11.	PMP140 267579	Bioinformatika	Bioinformatics	30+0+30+0	5	1 3	Graduate	Physics and Computer Science, specialization in Education; Physics (specialization in Biophysics); Mathematics and Physics, specialization in Education
12.	PMB513 212276	Biološka oceanografija	Biological oceanography	30+15+0+0	4	4	Undergraduate	Biology
13.	PPB253 173081	Citogenetičke analize kromosoma	Cytogenetic Chromosome Analysis	10+5+15+0	2	5	Undergraduate	Biology; Biology and Chemistry
14.	PMM152 240159	Diferencijalni i integralni račun I	Differential and Integral Calculus I	45+0+60+0	8.5	2	Undergraduate	Mathematics and Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro)); Mathematics and Computer Science, specialization in Education; Mathematics
15.	PMM156 240160	Diferencijalni i integralni račun II	DIFFERENTIAL AND INTEGRAL CALCULUS II	45+0+60+0	9	3	Undergraduate	Mathematics and Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Matematika i fizika (staro)); Mathematics and Computer Science, specialization in Education
16.	PMP267 216066	Dinamički sustavi u okolišu	Dynamical Systems in the Environment	30+20+0+0	4	1	Graduate	Physics (specialization in Environmental Physics)
17.	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)
18.	PMM810 173195	Diofantske jednadžbe	Diophantine equation	30+15+0+0	5	3 1	Graduate	Mathematics and Physics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Pure Mathematics);

								Mathematics (specialization in Education)
19.	PMPMSC 68256	Diplomski rad	Diploma Thesis	0+10+0+0	30	4	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics)
20.	PMPMSC 79688	Diplomski rad	Diploma Thesis	0+10+0+0	18	4	Graduate	Physics (specialization in Education)
21.	PMB10	Ekologija podzemnih staništa s biospeleologijom	Ekologija podzemnih staništa s biospeleologijom	15+0+0+0	5	2	Doctoral	Istraživanje u edukaciji u području prirodnih i tehničkih znanosti (Biologija)
22.	PMP122 267584	Eksperimentalne metode moderne fizike	Experimental Methods of Modern Physics	30+15+15+0	6	1	Graduate	Physics and Computer Science, specialization in Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Computational Physics)
23.	PMP264 216062	Ekstremne pojave u okolišu	Extreme Environmental Phenomena	30+0+15+0	4	3	Graduate	Physics (specialization in Environmental Physics)
24.	PMP003 251428	Elektricitet i magnetizam	Electricity and Magnetism	60+15+30+0	9	2 4	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro)); Mathematics (specialization in Applied Mathematics)
25.	PMP118 201707	Elektrodinamika	Electrodynamics	45+15+30+0	8	5	Undergraduate	Mathematics and Physics; Mathematics and Physics (specialization in Education);

								Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro)); Mathematics (specialization in Applied Mathematics)
26.	PMM019 111939	Elementarna geometrija	Elementary geometry	30+0+30+0	6	2 4	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics and Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Matematika i fizika (staro)); Mathematics and Computer Science, specialization in Education; Mathematics
27.	PMT168 79744	Energetika	Energetics	30+15+0+0	4	1	Graduate	Computer Science and Technics, specialization in Education
28.	PMP108 173241	Filozofija znanosti	Philosophy of Science	15+15+0+0	2	3 5	Undergraduate	Computer Science; Physics
29.	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); Physics and Computer Science, 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); Mathematics and Physics, specialization in Education

30.	PMP20E 227862	Fizika elementarnih čestica I	Elementary Particle Physics I	45+0+15+0	6	2 4	Graduate	Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Computational Physics); Mathematics and Physics, specialization in Education
31.	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)
32.	PMP163 216059	Fizika mora I	Ocean Physics I	30+0+15+0	5	3 1	Graduate	Physics (specialization in Education); Physics (specialization in Environmental Physics); Mathematics and Physics, specialization in Education
33.	PMP268 240173	Fizika mora II	Ocean Physics II	30+5+15+0	5	2 4	Graduate	Physics (specialization in Environmental Physics); Mathematics and Physics, specialization in Education
34.	PMM820 215449	Fourierova analiza i primjene	Fourier Analysis and Applications	30+0+30+0	5	4 6	Graduate Undergraduate	Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Applied Mathematics)
35.	PMB547 212274	Genetika i biotehnologija u agrikulturi	Genetics and Biotechnology in agriculture	30+10+20+0	4	3	Undergraduate	MP; Biology
36.	PMIK80 173003	Informatička praksa	Informatics Practice	0+0+0+176	5	5 6 4	Undergraduate Graduate	Computer Science; Computer Science and Technics, specialization in Education
37.	267487	Informatički projekt iz baza podataka	IT Project – Database	0+30+0+0	2	4	Undergraduate	Computer Science
38.	PMIH30 172995	Interakcija čovjeka i računala: osnove i principi	Human Computer Interaction:: Fundamentals and Principles	30+0+30+0	5	2 4	Graduate Undergraduate	Physics and Computer Science, specialization in Education; Computer Science; Computer Science and Technics, specialization in Education; Mathematics and Computer

								Science, specialization in Education; Mathematics (specialization in Computer Science)
39.	PMP134 267598	Istraživački rad	Research Project	0+30+0+0	6	3	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics)
40.	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)
41.	PMP407 186484	Istraživački rad iz biofizike	Research in Biophysics	10+20+0+0	5	3	Graduate	Physics (specialization in Biophysics)
42.	PMP26C 227855	Istraživački rad iz fizike okoliša	Research in Environmental Physics	10+20+30+0	6	3	Graduate	Physics (specialization in Environmental Physics)
43.	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)
44.	PMIK65 280038	Istraživački rad u informatičkom obrazovanju	Research in Computer Science Education	15+30+0+0	5	4	Graduate	Computer Science, specialization in Education; Mathematics and Computer Science, specialization in Education
45.	PPB264 79361	Izolacija i primjena eteričnih ulja	Isolation and Application of Essential Oils	15+0+15+0	2	2 6	Graduate Undergraduate	Biology and Chemistry, specialization in Education; Biology; Biology and Chemistry
46.	PMB714 280041	Karcinogeneza i mutageneza	Carcinogenesis and Mutagenesis	20+10+0+0	3	3	Graduate	Molecular Biology
47.	PMC321 280025	Kemija mirisa i parfema	The chemistry of fragrances and perfumes	30+0+0+0	2	5	Undergraduate	Biology and Chemistry
48.	PMS135 79108	Kineziološka aktivnost, fitness i zdravlje	Kinesiological activity, fitness and health	15+0+15+0	2	3 1	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); Biology and Chemistry, specialization in Education;

								Mathematics and Physics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Education); Computer Science, specialization in Education
49.	PMP116 186642	Klasična mehanika	Clasical Mechanics	45+0+45+0	8	3 5	Undergraduate	Mathematics and Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro)); Mathematics (specialization in Applied Mathematics)
50.	PMP110 251437	Klasična mehanika I	Classical Mechanics I	45+0+30+0	6	3	Undergraduate	Physics
51.	PMP111 251441	Klasična mehanika II	Classical Mechanics II	45+0+30+0	6	4	Undergraduate	Physics
52.	PMF5	Klimatske promjene, meteorologija i oceanografija u nastavi	Klimatske promjene, meteorologija i oceanografija u nastavi	15+0+0+0	5	2	Doctoral	Istraživanje u edukaciji u području prirodnih i tehničkih znanosti (Fizika)
53.	PMP169 227866	Klimatski sustav	Climate System	35+0+30+0	6	3	Graduate	Physics (specialization in Environmental Physics)
54.	PMS174 159956	Kognitivna psihologija	Cognitive psychology	15+15+15+0	4	4	Graduate	Mathematics (specialization in Education)
55.	PMS174 280032	Kognitivna psihologija	Cognitive psychology	15+15+0+0	2	4 2	Graduate	Physics (specialization in Education); Biology and Chemistry, specialization in Education; Computer Science and Technics, specialization in Education; Mathematics and Physics, specialization in Education; Computer Science, specialization in Education; Mathematics and Computer Science, specialization in Education;

								Mathematics (specialization in Education)
56.	PMM116 60987	Kompleksna analiza	Complex analysis	30+0+30+0	6	6 5	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics and Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro)); Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics)
57.	PMSN09 134030	Komunikacijske vještine	Communication Skills	15+15+0+0	2	6 2 4	Undergraduate Graduate	Computer Science; Physics (specialization in Education); Biology and Chemistry, specialization in Education; Computer Science and Technics, specialization in Education; Mathematics and Physics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Education)
58.	PMM205 79334	Kriptografija	Cryptography	30+15+15+0	5	3 1	Graduate	Mathematics and Physics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Computer Science); Mathematics (specialization in

								Pure Mathematics); Mathematics (specialization in Education); Mathematics (specialization in Statistics and Computer Science)
59.	PMP117 251451	Kvantna fizika	Quantum Physics	40+15+30+0	6	6	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro)); Mathematics (specialization in Applied Mathematics)
60.	PMM153 240155	Linearna algebra I	Linear Algebra I	45+0+60+0	8.5	1	Undergraduate	Mathematics and Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro)); Mathematics and Computer Science, specialization in Education; Mathematics
61.	PMM154 240156	Linearna algebra II	Linear algebra II	45+0+60+0	8.5	2	Undergraduate	Mathematics and Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro)); Mathematics and Computer Science, specialization in Education; Mathematics
62.	PPB266 79366	Makrozoobentos krških tekućica	Macrozoobenthos of the Karst Streams	15+15+0+0	2	5	Undergraduate	Biology; Biology and Chemistry
63.	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)
64.	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)
65.	PMP107 251439	Matematičke metode fizike I	Mathematical methods of physics I	45+15+30+0	6	3	Undergraduate	Physics
66.	PMP101 87742	Matematičke metode fizike II	Mathematical Methods of Physics II	45+0+30+0	6	4	Undergraduate	Physics
67.	PMP102 79383	Matematičke metode fizike III	Mathematical Methods of Physics III	30+0+30+0	5	5	Undergraduate	Physics
68.	PMMN01 133974	Matematika	Mathematics	30+0+30+0	5	1	Undergraduate	MP; Biology; Biology and Chemistry
69.	PMM005 60463	Matematika I	MATHEMATICS I	45+0+45+0	8	1	Undergraduate	Physics
70.	PMM851 267456	Matematika I	Mathematics I	30+0+30+0	7	1	Undergraduate	Computer Science; Computer Science and Technics
71.	PMT154 79737	Materijali	Materials	45+0+15+0	5	3	Undergraduate	Computer Science and Technics
72.	PMP241 267668	Medicinska fizika	Medical Physics	45+5+10+0	6	2	Graduate	Physics (specialization in Biophysics)
73.	PMP001 251426	Mehanika	Mechanics	60+15+30+0	9	1 3	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro)); Mathematics (specialization in Applied Mathematics)
74.	PMP161 240172	Meteorologija I	Meteorology I	30+5+15+0	5	3 1	Graduate	Physics (specialization in Education);

								Physics (specialization in Environmental Physics); Mathematics and Physics, specialization in Education
75.	PMP260 216065	Meteorologija II	Meteorology II	30+0+15+0	5	2	Graduate	Physics (specialization in Environmental Physics)
76.	PMP050 79119	Metodika nastave fizike I	Physics Education I	30+30+30+0	6	2	Graduate	Physics and Computer Science, specialization in Education; Physics (specialization in Education); Mathematics and Physics, specialization in Education
77.	PMP150 79127	Metodika nastave fizike II	Physics Education II	30+30+30+0	6	3	Graduate	Physics and Computer Science, specialization in Education; Physics (specialization in Education); Mathematics and Physics, specialization in Education
78.	PMP250 79687	Metodika nastave fizike III	Physics Education III	30+30+30+0	6	4	Graduate	Physics (specialization in Education); Mathematics and Physics, specialization in Education
79.	PMM133 97073	Metodika nastave primijenjene matematike	Methods of Instructions in Applied Mathematics	30+0+30+0	5	4 2	Graduate	Mathematics and Physics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Education)
80.	PMIH40 279897	Metodologija dizajna interakcija	Interaction Design Methodology	30+15+0+0	5	5 1	Undergraduate Graduate	Computer Science; Computer Science, specialization in Education
81.	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)
82.	PMM601 245249	Metrički prostori	Metric spaces	45+0+0+0	6	1	Graduate	Mathematics (specialization in Pure Mathematics)
83.	PMM913 160065	Mjera i integral	Measure and integral	30+0+30+0	6	1	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Statistics and Computer Science)
84.	PMP26D 227852	Modeliranje fluida u okolišu	Environmental Fluid Dynamics	30+20+10+0	6	3	Graduate	Physics (specialization in Environmental Physics)
85.	PMP249 227869	Modeliranje i simulacije biomakromolekula	Modelling and Simulations of Biomacromolecule	30+0+30+0	5	3	Graduate	Physics (specialization in Biophysics)
86.	PMP008 251444	Moderna fizika	Modern Physics	45+15+30+0	6	4	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro))
87.	PMP207 186483	Moderna spektroskopija	Modern spectroscopy	30+15+15+0	6	3 1	Graduate	Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics); Physics (specialization in Computational Physics)
88.	PMB545 212278	Molekularna genetika	Molecular Genetics	30+15+0+0	3.5	4	Undergraduate	Biology
89.	PMP200 251483	Napredna kvantna fizika	Advanced Quantum Physics	30+15+30+0	6	1	Graduate	Physics and Computer Science, 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); Mathematics and Physics, specialization in Education
90.	PMP115 267519	Napredna statistička fizika	Advanced Statistical Physics	45+15+15+0	6	6	Undergraduate	Physics
91.	PMS176 216041	Nasilje među djecom	Nasilje među djecom	15+15+0+0	2	4 2	Graduate	Physics (specialization in Education); Biology and Chemistry, specialization in Education; Computer Science, specialization in Education; Computer Science and Technics, specialization in Education; Mathematics and Physics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Education)
92.	PMM605 245253	Normirani prostori	Normed spaces	45+0+0+0	6	2	Graduate	Mathematics (specialization in Pure Mathematics)
93.	PMP203 267577	Nuklearna fizika	Nuclear Physics	30+0+30+0	6	4 2	Graduate	Physics and Computer Science, 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); Mathematics and Physics, specialization in Education

94.	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)
95.	PMP402 88341	Numeričko modeliranje elektronske strukture	Numerical Modelling of Electronic Structure	30+0+15+0	5	3	Graduate	Physics (specialization in Computational Physics)
96.	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)
97.	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
98.	PMM607 245254	Operatori na normiranim prostorima	Operators on Normed Spaces	45+0+0+0	6	3	Graduate	Mathematics (specialization in Pure Mathematics)
99.	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)
100.	PMP130 251448	Osnove astronomije i astrofizike	Fundamentals of Astronomy and Astrophysics	30+15+0+0	3	2 4 6	Graduate Undergraduate	Physics and Computer Science, specialization in Education; Physics; Physics (specialization in Education); Physics (specialization in Environmental Physics); Physics (specialization in Computational Physics); Mathematics and Physics, specialization in Education
101.	PPB259 79354	Osnove histoloških tehnika	Basic histological techniques	15+0+15+0	2	5	Undergraduate	Biology and Chemistry

102.	PMIG20 267531	Osnove teorije strategijskih igara	Osnove teorije strategijskih igara	45+0+0+0	5	1	Graduate	Computer Science, specialization in Education
103.	PMS175 216033	Pedagogija adolescencije	Pedagogija adolescencije	15+15+0+0	2	3 1	Graduate	Physics (specialization in Education); Biology and Chemistry, specialization in Education; Computer Science, specialization in Education; Computer Science and Technics, specialization in Education; Mathematics and Physics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Education)
104.	PMF3	Povijest i filozofija suvremene fizike	Povijest i filozofija suvremene fizike	15+0+0+0	5	2	Doctoral	Istraživanje u edukaciji u području prirodnih i tehničkih znanosti (Fizika)
105.	PMP009 68195	Povijest klasične fizike	History of Classical Physics	30+0+0+0	3	1 3	Graduate	Physics and Computer Science, 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); Mathematics and Physics, specialization in Education; Mathematics (specialization in Pure Mathematics)
106.	PMP103 68220	Povijest moderne fizike	History of Modern Physics	30+0+0+0	3	2 4	Graduate	Engineering Physics (specialization in Thermodynamic Systems); Engineering Physics (specialization in Mechanical Systems); Physics and Computer Science, 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); Mathematics and Physics, specialization in Education
107.	PMP142 251486	Praktikum iz biofizike	Laboratory in Biophysics	10+0+40+0	4	2	Graduate	Physics (specialization in Biophysics)
108.	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 (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro))
109.	PMP011 251438	Praktikum iz mehanike	Laboratory in Mechanics	0+0+40+0	3	3	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro))
110.	PMC213 134001	Praktikum iz metodike nastave kemije I	Laboratory in Chemistry Education I	0+0+45+0	2	3	Graduate	Biology and Chemistry, specialization in Education
111.	PMP20F 186482	Praktikum iz moderne fizike	Laboratory in Modern Physics	0+0+40+0	3	1	Graduate	Physics and Computer Science, specialization in Education; Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Biophysics);

								Physics (specialization in Computational Physics)
112.	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 (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro))
113.	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 (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro))
114.	PMIG10 87288	Primijenjena statistika	Applied Statistics	30+0+30+0	6	4	Undergraduate	Computer Science
115.	PMB530 201580	Primjena mikroskopijskih tehnika u prirodnim znanostima	Primjena mikroskopijskih tehnika u prirodnim znanostima	15+0+15+0	2	4	Undergraduate	Biology
116.	PMP074 251427	Primjena programiranja u fizici	Application of Programming in Physics	30+0+30+0	5	2	Undergraduate	Physics
117.	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)
118.	PPC210 79371	Prirodni toksini u moru	Natural toxins in the sea	15+0+0+0	2	4 6	Undergraduate	Biology; Biology and Chemistry
119.	PMID35 173004	Programiranje mobilnih aplikacija	Mobile Applications Programming	30+0+30+0	5	3	Graduate	Computer Science, specialization in Education; Computer Science and Technics, specialization in Education; Mathematics and Computer Science, specialization in Education

120.	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; Physics (specialization in Computational Physics); Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Computer Science)
121.	PMP153 267580	Prvi koraci u istraživanju fizike	First Steps in Physics Research	0+30+0+0	3	1 3	Graduate	Physics and Computer Science, specialization in Education; Physics (specialization in Education); Mathematics and Physics, specialization in Education
122.	PMP073 279889	Računalne metode u fizici	Computational methods in physics	30+0+30+0	4	1 5	Undergraduate	Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro))
123.	PMII60 147925	Računalni vid	Computer vision	30+0+30+0	5	2 4 6	Graduate Undergraduate	Physics and Computer Science, specialization in Education; Computer Science; Computer Science, specialization in Education; Computer Science and Technics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Computer Science)
124.	PMT112 279900	Računalom podržani dizajn proizvoda (CAD)	Computer aided product design (CAD)	30+0+30+0	5	6 2 4	Undergraduate Graduate	Computer Science; Computer Science, specialization in Education; Computer Science and Technics, specialization in Education

125.	PMP2PR 240207	Računarska fizika s industrijskom praksom	Computational Physics with Industry Placements	15+0+0+0	30	3	Graduate	Physics (specialization in Computational Physics)
126.	PMIC50 148038	Raspodijeljeni sustavi	Distributed systems	30+0+30+0	5	2 4	Graduate	Physics and Computer Science, specialization in Education; Computer Science, specialization in Education; Computer Science and Technics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Computer Science)
127.	PMP152 79240	Seminar iz metodike fizike s nastavnom praksom	Seminar in Physics Education	0+60+0+0	4	4	Graduate	Physics and Computer Science, specialization in Education; Physics (specialization in Education); Mathematics and Physics, specialization in Education
128.	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)
129.	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)
130.	PMP114 267518	Statistička fizika	Statistical Physics	45+0+30+0	6	1 5	Graduate Undergraduate	Physics and Computer Science, specialization in Education; Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro))
131.	PMM230 111896	Statistika	STATISTIC	30+0+30+0	6	3	Graduate	Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics);

								Mathematics (specialization in Statistics and Computer Science)
132.	PMM861 201568	Statistika	STATISTICS	30+0+15+0	4	2	Undergraduate	Biology
133.	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)
134.	PMS250 172985	Strani jezik u struci I (Engleski)	English for Specific Purposes I	0+30+0+0	2	1	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Computer Science; Computer Science and Technics; Physics
135.	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
136.	PMS251 172991	Strani jezik u struci II (Engleski)	English for Specific Purposes II	0+30+0+0	2	2	Undergraduate	Mathematics (staro); Mathematics and Computer Science (staro); Computer Science; Computer Science and Technics; Physics
137.	PMS253 173171	Strani jezik u struci II (Engleski)	English for Specific Purposes (II)	0+30+0+0	2	2	Undergraduate	Biology; Biology and Chemistry
138.	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)
139.	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 (specialization in Education); Mathematics and Physics

								(Inženjerski); Mathematics and Physics (Matematika i fizika (staro))
140.	PMP106 63969	Temeljni pojmovi u fizici	Fundamental Concepts in Physics	30+15+0+0	3	3 5	Undergraduate Graduate	Mathematics (staro); Physics; Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science)
141.	PMP11C 79666	Temeljni pojmovi u kvantnoj fizici	Fundamental Concepts in Quantum Physics	30+15+0+0	4	6 4	Undergraduate Graduate	Physics; Mathematics (specialization in Pure Mathematics)
142.	PMM614 245245	Teorija dizajna	Design Theory	45+0+0+0	5	4 2	Graduate	Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Computer Science); Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Mathematics (specialization in Statistics and Computer Science)
143.	PMM806 201744	Teorija grafova	Graph theory	30+0+30+0	5	6 4 2	Undergraduate Graduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Computer Science); Mathematics (specialization in Statistics and Computer Science); Mathematics (specialization in Mathematics); Mathematics (specialization in Applied Mathematics)
144.	PMP401 267581	Teorija relativnosti	Relativity	30+0+30+0	6	1 3	Graduate	Physics and Computer Science, specialization in Education; Physics (specialization in Education);

								Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Computational Physics); Mathematics and Physics, specialization in Education
145.	PMM112 79236	Teorija skupova	Set theory	30+0+30+0	6	4	Undergraduate Graduate	Mathematics (staro); Mathematics and Computer Science (staro); Mathematics and Physics, specialization in Education; Mathematics (specialization in Mathematics); Mathematics (specialization in Computer Science); Mathematics (specialization in Applied Mathematics)
146.	PMP007 251443	Termodinamika	Thermodynamics	60+15+30+0	9	4	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro))
147.	PMP20C 251496	Termodinamika nepovratnih procesa	Irreversible Process Thermodynamics	45+0+15+0	6	3	Graduate	Physics (specialization in Biophysics); Physics (specialization in Computational Physics); Mathematics and Physics, specialization in Education
148.	PPC209 79370	Toksikologija	Toxicology	30+0+0+0	2	1 5	Graduate Undergraduate	Biology and Chemistry, specialization in Education; Biology and Chemistry
149.	PMB735 251493	Toksikologija	Toxicology	30+0+0+0	3	3	Graduate	Molecular Biology
150.	PMS160 79109	Upravljanje razredom	Classroom management	15+15+0+0	2	3 1	Graduate	Physics and Computer Science, specialization in Education; Physics (specialization in Education); Biology and Chemistry,

								specialization in Education; Computer Science, specialization in Education; Computer Science and Technics, specialization in Education; Mathematics and Physics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Education)
151.	PMB711 251477	Uvod u biofiziku stanice	Uvod u biofiziku stanice	30+5+10+0	3	3	Graduate	Molecular Biology
152.	PMM120 68173	Uvod u diferencijalnu geometriju	Introduction to differential geometry	30+0+30+0	6	6 2 4	Undergraduate Graduate	Physics; Physics (specialization in Computational Physics); Mathematics and Physics, specialization in Education; Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Mathematics (specialization in Applied Mathematics)
153.	PMP096 79401	Uvod u fiziku	Introduction to Physics	45+0+15+0	4	2	Undergraduate	Computer Science and Technics
154.	PMP160 279896	Uvod u fiziku okoliša	Introduction to Environmental Physics	30+0+15+0	4	6 4	Undergraduate Graduate	Physics; Mathematics and Physics, specialization in Education
155.	PMP236 227859	Uvod u kvantnu teoriju polja	Introduction to Quantum Field Theory	30+0+15+0	5	3	Graduate	Physics (specialization in Astrophysics and Elementary Particle Physics)
156.	PMM700 201624	Uvod u matematičku logiku i teoriju skupova	Introduction to Mathematical Logic and Set Theory	30+0+30+0	5	5 3	Undergraduate	Mathematics and Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Matematika i fizika (staro)); Mathematics and Computer Science, specialization in Education

157.	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)
158.	PMP165 216064	Uvod u obradu podataka	Introduction to Data Analysis	20+0+30+0	5	2	Graduate	Physics (specialization in Environmental Physics)
159.	PMP381 68247	Uvod u supravodljivost	Introduction to Superconductivity	30+0+0+0	3	3	Graduate	Physics (specialization in Education); Physics (specialization in Astrophysics and Elementary Particle Physics); Physics (specialization in Computational Physics)
160.	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)
161.	PMII10 79324	Uvod u umjetnu inteligenciju	Introduction to Artificial Intelligence	30+0+30+0	5	5 1 3	Undergraduate Graduate	Mathematics (staro); Mathematics and Computer Science (staro); Physics and Computer Science, specialization in Education; Computer Science; Physics; Computer Science and Technics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Pure Mathematics); Mathematics (specialization in Education); Mathematics (specialization in Mathematics);

								Mathematics (specialization in Computer Science)
162.	PMP006 251436	Valovi i optika	Waves and Optics	60+15+30+0	9	3 5	Undergraduate	Mathematics and Physics; Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro)); Mathematics (specialization in Applied Mathematics)
163.	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)
164.	PMM809 173379	Vrednovanje u nastavi	ASSESSMENT IN EDUCATION	0+30+0+0	3	4 6	Graduate Undergraduate	Mathematics and Physics, specialization in Education; Mathematics and Computer Science, specialization in Education; Mathematics (specialization in Education)
165.	PMBN29 280024	Začinsko i aromatsko bilje	Spices and Aromatic Herbs	15+15+0+0	2	2 6	Graduate Undergraduate	Biology and Chemistry, specialization in Education; Biology; Biology and Chemistry
166.	PMPBSC 251453	Završni rad	Undergraduate Thesis	0+15+0+0	5	6	Undergraduate	Physics
167.	PMPBSC 251507	Završni rad	Undergraduate Thesis	0+15+0+0	3	6	Undergraduate	Mathematics and Physics; Mathematics and Physics (specialization in Education); Mathematics and Physics (Inženjerski); Mathematics and Physics (Matematika i fizika (staro))
168.	PMP105 173817	Znanstvena komunikacija	Scientific Communication	20+10+0+0	2	4 2	Graduate	Physics and Computer Science, 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); Mathematics and Physics, specialization in Education

<table>
<tr><td>Subject name</td><td colspan="6">3D printing</td></tr>
<tr><td>ID</td><td>PMT201</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">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">– 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...</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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</td></tr>
<tr><td>Syllabus</td><td colspan="6">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
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</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">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 rowspan="5">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>Experimental work</td><td>1</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></td><td></td><td></td></tr>
<tr><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 rowspan="10">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">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 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 colspan="4">Ian Gibson, David Rosen, Brent Stucker, Mahyar Khorasani: Additive ManufacturingTechnologies, Springer, 2021.</td><td></td><td></td></tr>
<tr><td colspan="4">Mohammed Maniruzzaman: 3D and 4D Printing in Biomedical Applications, Wiley-VCH, 2019.</td><td></td><td></td></tr>
<tr><td colspan="4">Georgios Tsoulfas, Petros I. Bangeas, Jasjit S. Suri: 3D Printing: Applications in Medicine and Surgery, Elsevier, 2020.</td><td></td><td></td></tr>
<tr><td colspan="4">Deepak M. Kalaskar: 3D Printing in Medicine, Elsevier, 2017.</td><td></td><td></td></tr>
<tr><td colspan="4">Sanjay ¬Kumar: Additive Manufacturing Processes, Springer, 2020.</td><td></td><td></td></tr>
<tr><td colspan="4">John O. Milewski: Additive Manufacturing of Metals – From Fundamental Technology to Rocket Nozzles, Medical Implants, and Custom Jewelry, Springer, 2017.</td><td></td><td></td></tr>
<tr><td colspan="4">Ehsan Toyserkani, Dyuti Sarker, Osezua Obehi Ibhadode, Farzad Liravi, Paola Russo, Katayoon Taherkhani: Metal Additive Manufacturing, Wiley, 2022.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Richard Leach, Simone Carmignato: Precision Metal Additive Manufacturing, CRC Press, 2021.</td></tr>
</table>

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	Learning Analytics in Computer Based Education		
ID	PMIK25	Study year	1.
Lecturer	prof. dr. sc. Ani Grubišić	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	30%

Subject description	
Subject goals	The aim is to acquire knowledge about the application of learning analytics in a Computer Based Education.
Enrolment requirements	Course enrolment requirements: None Entry competences: basic usage of computer
Learning outcomes	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.
Syllabus	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)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ 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>PMM502</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
☐ 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">Pohađanje nastave, rješavanje domaćih zadaća</td></tr>
</table>

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)						

Subject name	Data Analysis in High Energy Physics						
ID	PMP272	Study year	2.				
Lecturer	izv. prof. dr. sc. Toni Šćulac	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	Teaching students basics of data analysis in high energy physics.
Enrolment requirements	Introduction to elementary particles.
Learning outcomes	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
Syllabus	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

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	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	izv. prof. dr. sc. Goran Zaharija	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	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	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory	☐ ☐ ☐ ☐

	☐ Combined online		☐ 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 | S | E | P
30 | 0 | 15 | 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">
<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>
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</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 colspan="3">-</td></tr>
</table>
</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	doc. dr. sc. Marin Vojković	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	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory	☐ ☐ ☐ ☐

	Combined online		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)			

<table>
<tr><td>Subject name</td><td colspan="7">Databases</td></tr>
<tr><td>ID</td><td>PMIH10</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Marko Rosić</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">0%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Understanding the basic concepts of relational data model. The acquisition of knowledge and skills needed in the design of relatively simple databases based on the relational model. Acquiring knowledge of syntax and semantics of SQL language and understanding the SQL queries execution plan. Object oriented representation of the relational database.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Admission requirements: none.
Entry competences: user level using the operating system, knowledge of object-oriented programming concepts, basic knowledge of C #.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students will be able to:
1. define the basic concepts of relational database model
2. Establish relational model of relatively simple problems from the real world which are described in natural language
3. Introduce a relational database object
4th use SQL query language for searching and updating relational database
5th understand the plan of execution of SQL queries and indexes role in it
6th understand the basic concepts related to the administration and the security database</td></tr>
<tr><td>Syllabus</td><td colspan="6">Week 1:
Introduction to the subject. The information and data. The role of the database in the information system. Historical Development of databases: file, hierarchical, network, relational and object databases.
Exercises: connect the client - the user interface editor SQL queries - with a system for relational database management MS SQL Server. Create a database using a graphical user interface. Data types.
Tjedan2:
The terms of the relational data model. Relational Algebra (Part 1): Operation Union, intersection, difference, projections and restrictions. Incomplete information and the NULL value. The properties of the relational query language SQL.
Exercises: The syntax and semantics of SQL (Part 1): select-from-where. Frequently used functions in queries. Operations with NULL values.
Week3:
Relational Algebra (Part 2): theta and natural joining, aggregation functions.
Exercises: The syntax and semantics of SQL (Part 2): inner join, left and right outer join, and full join. Workout queries over the prepared database.
Week4:
Views. DDL part of SQL. Codd's rules. The structure of a typical system for relational database management.
Exercises: The syntax and semantics of SQL (Part 3): insert into, update from, delete from, create, alter and drop.
Tjedan5:
The creation of the relational data model. The integrity and consistency of the database. Restrictions in order to preserve integrity.
Exercises: nested SQL queries. SQL queries aggregation: group by - having.
Workout queries.
Tjedan6:</td></tr>
</table>

	Functional dependencies data. Normalization. Normal forms: 1NF, 2NF and 3NF. Exercises: Introduction to SQL execution plan instruction. Workout queries. Tjedan7: Normal forms: Boyce-Codd, 4NF4 and 5NF. Exercise: Preparing for the first midterm. Tjedan8: ER model (part 1): identification of entities and their attributes. The types of connections between the entities. Exercise: The first colloquium. Tjedan9: ER model (Part 2): decomposition connection M: N recursive relationship. Exercises: Design ER model (Part 1) Based on the analysis of the problem described in natural language. Tjedan10: Study example of creating an ER model. Exercises: Design ER model (part 2). Implementation of relational schemas. Tjedan11: Indices. Optimizing SQL queries. Materialized views. Exercises: practicing design ER model. Tjedan12: Transactions. Types of locking elements of a relational database. Triggers, stored procedures and functions. Exercise: Optimizing SQL queries. Tjedan13: Properties LINQ query language. Presentation of object-relational database. Exercises: tool LINQ to SQL Classes. Linking to the relational database management from the application program. LINQ queries in a simple console application. Tjedan14: The basic database administration. The management of user rights. Backing up and restoring. Exercise: Preparing for the second midterm. Tjedan15: The role of the log (Eng. Log) database. Database recovery after collapsing. The term replication. Distributed Databases. Exercise: The second colloquium
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Lecture attendance 70%, exercise attendance 70%, 3 homework, 2 tests, written and oral exam. Students who are successful at colloquia go to the oral exam.

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

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">Grading and evaluating student work in class and at the final exam Activity of students in lectures and exercises (presence at lectures and exercises, addressing the challenges of homework) (20%).
Written exam (40%): The semester are held two tests with the tasks of the SQL language, ie, design relational database. Each of them is scored on a scale of 0-50 points. Students who achieve at least 25 points in each colloquium released a written exam. Other students take a written examination, which substantially corresponds to the colloquia.
Oral exam (40%) 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="2">Required literature</td><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td>Mladen Varga: Baze podataka - Konceptualno, logičko i fizičko modeliranje podataka, Društvo za razvoj informacijske pismenosti (DRIP), Zagreb, 1994.</td><td>20</td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">Tonći Dadić: Baze podataka - skripta: http://www.pmfst.unist.hr/~tdadic/Dadic_BazePodataka.pdf</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>

Subject name	Biophysics		
ID	PMP141	Study year	2.
Lecturer	prof. dr. sc. Larisa Zoranić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 45 S: 15 E: 30 P: 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	[x] Lectures [x] Seminars [x] 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
Colloquiums | Oral exam
Written exam | Project</td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">Ocjena se utvrđuje na temelju ocjena: • Kolokvija (25% ocjene) • Seminarskog rada (50% ocjene) • Usmene prezentacije (25% ocjene)</td></tr>
<tr><td>Required literature</td><td>Title</td><td>Number of</td><td>Availability on other medium</td></tr>
</table>

		copies available	
	William Yost: Fundamentals of Hearing Science		
Supplementary literature	• 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		
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)			

Subject name	Bioinformatics		
ID	PMP140	Study year	2.
Lecturer	izv. prof. 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	Elective	Online percentage	0%
Subject description			
Subject goals	The main goal of the course is to acquaint students with the available tools that bioinformatics offers for analyzing the sequence and structure of proteins and nucleic acids so that by the end of the course they will be independent in performing analyses. The course will present the tools of structural bioinformatics, phylogenetics, and genomics and proteomics.		
Enrolment requirements	To successfully follow bioinformatics courses, prior knowledge of biochemistry and biophysics is required. More specifically, knowledge of the structure and physico-chemical properties of nucleotides and amino acids is required, which is covered in the previously attended courses of the students.		
Learning outcomes	After completing the course, students should: 1) Know biological databases 2) Know the tools for comparing nucleic acid sequences 3) Know the tools for comparing protein sequences 4) Predict the structure of proteins 5) Understand phylogenetic trees and their construction 6) Understand genome sequencing and mapping 7) Be independent in choosing tools according to analysis needs 8) Be independent in the interpretation of results obtained using bioinformatics tools 9) Be able to criticaly analyse publicly available bioinformatics tools, i.e. be able to recognize false-negative and false-positive results		
Syllabus	Weekly lesson plan: 1) Introduction to bioinformatics, familiarization with the history and development and definition of the field 2) and 3) Getting to know databases: literature databases, databases of gene and protein sequences, protein structures, functional domains and complete genomes 4) and 5) Simple and multiple alignment of nucleic acid and protein sequences, various algorithms and tools for sequence alignment 6) and 7) Prediction of secondary and tertiary structure of proteins: modeling by homology and tools used for said predictions 8) and 9) Programs for visualization of protein structure 10) and 11) Basics of molecular phylogenetics and algorithms for the construction of phylogenetic trees 12) and 13) Genome mapping, sequencing and annotation and functional genomics 14) and 15) Analysis of protein expression at the proteome level, post-translational modifications		
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐

Student obligations	Attendance and commitment of the student in class, making assignments in class, making assignments at home, making a seminar that includes independent research of a physical problem, writing a report and presenting it.						
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	The conditions for taking the exam are: the ability to use existing bioinformatics tools. Assessment through exercises on the computer, homework and final seminar. The grade is concluded according to the grade of the student's effort in class and the grade of the seminar.						
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	
Supplementary literature	[1] Supratim Choudhuri: Bioinformatics for Beginners; Academic Press; 2014, Elsevier Inc. [2] Scientific papers, lectures						
Quality assurance	Student evaluation through anonymous questionnaires at the end of the course.						
Other (in the opinion of the proponent)							

Subject name	Biological oceanography		
ID	PMB513	Study year	2.
Lecturer	doc. dr. sc. Antonela Sovulj	Points value (ECTS)	4.0
Associates		Class execution (number of hours in semester)	L: 30, S: 15, E: 0, P: 0
Subject status	Compulsory	Online percentage	10%

Subject description	
Subject goals	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.
Enrolment requirements	None
Learning outcomes	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.
Syllabus	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.
Teaching types	[x] Lectures [x] Seminars [ ] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [ ] Individual assignments [ ] 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="7">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.
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,</td></tr>
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<table>
<tr><td></td><td colspan="6">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.</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">Obveze studenata/studentica su redovito pohađanje nastave (predavanja), izvođenje laboratorijskih vježbi i samostalna priprema materijala za seminare.</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>0.5</td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td>1.0</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">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.</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">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.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">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.</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>

Subject name	Differential and Integral Calculus I							
ID	PMM152		Study year		1.			
Lecturer	prof. dr. sc. Milica Klaričić Bakula		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		10%			
Subject description								
Subject goals	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.							
Enrolment requirements	Prerequisite course: Introduction to Mathematical Analysis							
Learning outcomes	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.							
Syllabus	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							
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring		☑ Problem 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="3">DIFFERENTIAL AND INTEGRAL CALCULUS II</td></tr>
<tr><td>ID</td><td>PMM156</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Dino Peran</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: 45
S: 0
E: 60
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">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 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</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Taken course Differential and integral calculus I</td></tr>
</table>

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	Dynamical Systems in the Environment		
ID	PMP267	Study year	1.
Lecturer	izv. prof. dr. sc. Žarko Kovač	Points value (ECTS)	4.0
Associates		Class execution (number of hours in semester)	L: 30, S: 20, E: 0, P: 0
Subject status	Elective	Online percentage	0%

L	S	E	P
30	20	0	0

Subject description

Subject goals	– acquiring basic knowledge of dynamical systems and mathematical physics – provide knowledge on the use of differential equations in the description of physical systems, and extension of the methodology to the description of non-physical systems – get acquainted with the basics of the theory of deterministic chaos – provide basic knowledge of ecological, population and epidemiological modelling in relation to physical processes in the environment
Enrolment requirements	– Mathematical Methods of Physics 2 – differential equations – basic programming
Learning outcomes	1. Describe physical systems in the environment using differential equations. 2. Knowledge of the method of solving differential equations describing dynamical systems. 3. Perform linearization and stability analysis of systems. 4. Formulation of simple mathematical models of dynamic systems in the environment. 5. Introductory knowledge of ecological modelling. 6. Introductory knowledge of population modelling. 7. Introductory knowledge of epidemiological modelling.
Syllabus	1. Linear systems with examples from environmental physics (4h L, 10h S) 2. Nonlinear systems with examples from environmental physics (4h L, 10h S) 3. Linearization (2h) 4. System stability (2h) 5. Feedback (2h) 6. Phase space (2h) 7. Deterministic chaos (2h) 8. Ecological modelling (4h) 9. Population modelling (4h) 10. Epidemiological modelling (4h)
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	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 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 holds seminars on specific models of dynamical systems and together with students solves more complex problems analytically and numerically. In the 8th week of classes, students choose a model of a dynamic system that they analyse 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 / exam (1/3 grade), simulation (1/3 grade) and answers to the oral exam (1/3 grade).

Required literature	Title	Number of copies available	Availability on other medium
	Steven H. Strogatz Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering Perseus Books, 1994.		da
	J. D. Murray Mathematical Biology: An Introduction Springer, 2002.		da

Supplementary literature	Rudy Slingerland & Lee Kump Mathematical Modeling of Earth's Dynamical Systems Princeton University Press, 2011. Eugene M. Izhikevich Dynamical Systems in Neuroscience MIT Press, 2007. Edward Ott Chaos in dynamical systems Cambridge University Press, 1993.
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	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: 30, S: 30, E: 0, P: 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. 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.
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring ☑ Domaće zadaće ☐ ☐ ☐

<table>
<tr><td>Student obligations</td><td colspan="6">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 rowspan="5">Monitoring student work</td><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>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">1. Oral part: 2 partial exams or 1 full exam.
2. Written part: Seminar essay.</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">B. Lovrinčević, Dinamika atoma u plinovima i tekućinama, skripta, 2021.</td><td></td><td>e-learning</td></tr>
<tr><td>Supplementary literature</td><td colspan="6">[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 colspan="6">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
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	Diophantine equation		
ID	PMM810	Study year	1.
Lecturer	izv. prof. dr. sc. Marija Bliznac Trebješanin	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 15, E: 0, P: 0
Subject status	Compulsory	Online percentage	0%

Subject description

Subject goals	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.
Enrolment requirements	Requirements: Course passed: Introduction to Number Theory. Required competences: knowledge of different mathematical structures.
Learning outcomes	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
Syllabus	–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)
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ 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. 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

<table>
<tr><td></td><td>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>☐ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online
☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☑ Mentoring
☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td>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>Monitoring student work</td><td><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>30</td><td></td><td></td></tr>
</table></td></tr>
<tr><td>Assessment and evaluation of student work</td><td>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>Required literature</td><td><table>
<tr><th>Title</th><th>Number of copies available</th><th>Availability on other medium</th></tr>
<tr><td>Literature for the selected topic of the diploma thesis, as recommended by the mentor.</td><td></td><td>yes</td></tr>
</table></td></tr>
<tr><td>Supplementary literature</td><td>Articles from the current contents of the selected topic.</td></tr>
<tr><td>Quality assurance</td><td>1. Interviews with the student pre- and post-graduation.
2. Student surveys.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td></td></tr>
</table>

Subject name	Diploma Thesis						
ID	PMPMSC	Study year	2.				
Lecturer		Points value (ECTS)	18.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			0	10	0	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. To analyse professional and scientific literature. 2. To analyse a topic in physics that is outside of the scope of the standard study programme. 3. To apply orthographic, grammatical, and syntactical rules of the standard language in spoken and written communication. 4. To apply research methodology. 5. To apply presentation skills. 6. To use a computer for analysing and illustrating experimental and/or theoretical results. 7. To present complex physics concepts in a clear and concise manner. 8. To demonstrate the skill of coherent and professional composition of a professional and scientific text in physics by using metalanguage. 9. To prepare a satisfactory, linguistically and terminologically consistent thesis in line with the professional standards by thoroughly analysing the selected topic and by clearly and precisely presenting the research results. 10. To orally present the selected concepts and topics in physics and systematically and concisely demonstrate the fundamental knowledge of the field.
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. 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.
Teaching types	☐ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring
Student obligations	Consultations with the supervisor regarding the selected topic, preparation of the thesis, planning and presentation of seminar papers and public defence of the thesis. Preparation of the thesis.

Monitoring student work

Class attendance		Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums		Oral exam			
Written exam		Project	18		

Assessment and evaluation of student work	The final assessment of the graduate thesis includes the evaluation of the written thesis, of the public presentation of the thesis and of the answers to the questions related to the graduate thesis topic and physics in general.

Required literature

Title	Number of copies available	Availability on other medium
Literature related to the selected thesis topic as recommended by the supervisor.		yes

Supplementary literature	Research papers covering the selected thesis topic from the current journals.
Quality assurance	1. Interviews with the student pre- and post-graduation. 2. Student surveys.
Other (in the opinion of the proponent)	

Subject name	Ekologija podzemnih staništa s biospeleologijom						
ID	PMB10	Study year	1.				
Lecturer	prof. dr. sc. Biljana Apostolska	Points value (ECTS)	5.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			15	0	0	0	
Subject status	Elective	Online percentage	0%				

Subject description	
Subject goals	Usvajanje znanja o osnovnim tipovima podzemnih staništa uz abiotičke i biotičke čimbenike svakoga od njih te upoznati faunu endema i relikata koju nalazimo na tim staništima. Poseban naglasak je na zakonskoj regulativi zaštite ovih staništa u Hrvatskoj
Enrolment requirements	
Learning outcomes	Student će nakon položenog ispita moći: ➢ prepoznati osnovne tipove podzemnih staništa ➢ naučiti osnovne krške oblike ➢ objasniti i razumjeti abiotičke i biotičke parametre na navedenim staništima ➢ prepoznati endeme i relikte faune podzemnih staništa ➢ upoznati zakonsku regulativu vezanu uz zaštitu krša
Syllabus	Predavanja i seminari 1. Dinarski krš i njegovo rasprostranjenje u Hrvatskoj i u svijetu s osnovnim ekološkim značajkama (2 h) 2. Tipovi krških staništa (2 h) 3. Abiotički i biotički parametri na navedenim staništima (2 h) 4. Podjela organizama u podzemlju u njihove osnovne značajke (2 h) 5. Fauna podzemnih staništa (2 h) 6. Endemi i relikti (1 h) 7. Speleološki objekti (2 h) 8. Zakonska regulativ (2 h)
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Pohađanje nastave

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

	Written exam		Project			
Assessment and evaluation of student work	Usmeni ispit i seminarski rad					
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 (200					
	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	Usmeni ispit					
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	S	E	P	
			30	15	15	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)						

<table>
<tr><td></td><td colspan="6">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.</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">Independent work on experimental equipment, analysis of the results obtained and writing of reports. Preparation of a seminar paper. Participation in class</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>1</td><td>Paper</td><td>1</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>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 of student work</td><td colspan="6">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.</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>

	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	Extreme Environmental Phenomena		
ID	PMP264	Study year	2.
Lecturer	izv. prof. dr. sc. Jadranka Šepić	Points value (ECTS)	4.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 15, P: 0
Subject status	Elective	Online percentage	0%

Subject description	
Subject goals	Provide basic knowledge on extreme processes and conditions in the environment Enable students to extract and analyze extreme processes and conditions Provide techniques and methods for estimating frequency and strength of extremes in a changing climate
Enrolment requirements	Basics of physics Basics of mathematics
Learning outcomes	Gain knowledge on extreme events in the atmosphere, lithosphere and oceans Gain knowledge on statistics of extremes Learn how to extract and analyze extreme events
Syllabus	1. Definition of extremes (2 hours of lectures) 2. Ranking extreme events (2 hours of lectures) 3. Sources of extremes; preconditioning vs. Local effect (2 hours of lectures) 4. Extremes in the atmosphere: El Nino, La Nina, Hurricanes, tropical cyclones, hurricane strength winds, tornados, heat and cold waves (6 hours of lectures) 5. Extreme events in seas and oceans: storm surge, tsunami, meteotsunami, rogue waves, solitons (6 hours of lectures) 6. Extreme events in seismology: destructive earthquakes, landslides, volcanic eruptions (4 hours of lectures) 7. Statistic of extremes (6 hours of lectures) 8. Climate change and environmental extremes (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	1.5	Research		Practical work	1.5
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam	0.5		
	Written exam		Project			

Assessment and evaluation of student work	During the semester, students will analyze a selected extreme event. This analysis will include data analysis, statistical analysis, and estimation of frequency and strength of extremes in future climate. Students will present the results of this analysis in a seminar essay. The final grade is

	formed based on the practical training (50%), seminar essay (25%), and oral exam (25%).		
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.	0	da
	Mirko Orlić, Uvod u fizičku oceanografiju	5	ne
Supplementary literature	Roland B. Stull An Introduction to Boundary Layer Meteorology Kluwer, 1988. Emil Julius Gumbel Statistics of extremes Dover Publications, 2004		
Quality assurance	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)			

Subject name	Electricity and Magnetism						
ID	PMP003	Study year	2.				
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	☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory	☐ ☐ ☐ ☐				

	☐ Combined online		☐ 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)	

Subject name	Electrodynamics		
ID	PMP118	Study year	3.
Lecturer	izv. prof. dr. sc. Damir Kovačić	Points value (ECTS)	8.0
Associates		Class execution (number of hours in semester)	L: 45, S: 15, E: 30, P: 0
Subject status	Elective	Online percentage	20%
Subject description			
Subject goals	Upoznati studente s osnovama klasične elektrodinamike.		
Enrolment requirements	Nema		
Learning outcomes	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		
Syllabus	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.		
Teaching types	[x] Lectures [x] Seminars [x] Exercises [ ] Fully online [ ] Combined online	[ ] Fieldwork [ ] 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)	

Subject name	Elementary geometry		
ID	PMM019	Study year	1.
Lecturer	prof. dr. sc. Jurica Perić	Points value (ECTS)	6.0
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 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.
Enrolment requirements	/
Learning outcomes	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
Syllabus	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
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	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)						

Subject name	Energetics						
ID	PMT168	Study year	1.				
Lecturer	doc. dr. sc. Ivan Peko	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	30%				
Subject description							
Subject goals	Adopt basic knowledge of energetics and energy conversion and form a critical opinion about the efficient use of energy sources.						
Enrolment requirements	none.						
Learning outcomes	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.						
Syllabus	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. 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	☑ Lectures	☐ Fieldwork	☐

	☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☑ 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)	

Subject name	Philosophy of Science		
ID	PMP108	Study year	3.
Lecturer	prof. dr. sc. Mile Dželalija	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	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.
Enrolment requirements	None
Learning outcomes	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.
Syllabus	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]
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☑ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ 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	Solid State Physics		
ID	PMP201	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: 30 S: 0 E: 30 P: 0
Subject status	Compulsory	Online percentage	20%
Subject description			
Subject goals	• 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.		
Enrolment requirements	• quantum mechanics • statistical mechanics • electrodynamics		
Learning outcomes	• 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.		
Syllabus	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). 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). 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).
Teaching types	[x] Lectures [ ] Seminars [x] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [x] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring
Student obligations	Attendance of at least 50% of lectures and exercises. At least 50% of solved homework problems handed in.

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)	

<table>
<tr><td>Subject name</td><td colspan="3">Elementary Particle Physics I</td></tr>
<tr><td>ID</td><td>PMP20E</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>6.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 45
S: 0
E: 15
P: 0</td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>25%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">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.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Stečeni ishodi učenja predmeta Klasična elektrodinamika i Kvantna fizika</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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.</td></tr>
<tr><td>Syllabus</td><td colspan="3">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.</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	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)	

Subject name	Elementary Particle Physics II		
ID	PMP234	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 45 0 15 0
Subject status	Elective	Online percentage	25%
Subject description			
Subject goals	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.		
Enrolment requirements	Stečeni ishodi učenja predmeta Fizika elementarnih čestica I.		
Learning outcomes	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.		
Syllabus	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. 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	☐ Fieldwork ☑ Individual assignments ☑ Multimedia	☐ ☐ ☐

	☐ Fully online ☐ Combined online		☐ 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="3">Ocean Physics I</td></tr>
<tr><td>ID</td><td>PMP163</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Žarko Kovač</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: 15, 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">– 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="3">– basics of physics
– basics of mathematics
– basics of fluid mechanics
– basic programming</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">– 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="3">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>☑ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☑ domaće zadaće
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Attend at least 70% of lectures and 70% of exercises.</td></tr>
<tr><td>Monitoring student work</td><td colspan="3">

Class attendance	1	Research		Practical work	
Experimental work		Paper		Domaće zadaće	1
Essay		Seminar paper			

</td></tr>
</table>

	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 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		
	Robert H. Stewart Introduction To Physical Oceanography Texas A & M University, 2000		
Supplementary literature	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		
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="3">Ocean Physics II</td></tr>
<tr><td>ID</td><td>PMP268</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Žarko Kovač</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: 5
E: 15
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">– 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="3">– Ocean Physics I
– Introduction to Fluid Mechanics
– programming</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">– 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="3">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
☐ Fully online
☐ Combined online</td><td>☑ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☑ domaće zadaće
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Attend at least 70% of lectures and 70% of exercises.</td></tr>
<tr><td>Monitoring student work</td><td colspan="3">Class attendance: 1
Research:
Practical work:
Experimental work:
Paper:
Domaće zadaće: 1</td></tr>
</table>

	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)	

Subject name	Fourier Analysis and Applications		
ID	PMM820	Study year	3.
Lecturer	prof. dr. sc. Saša Krešić Jurić	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	20%

Subject description

Subject goals	To introduce students to the fundamentals of Fourier series, Fourier transform and applications to signal processing.
Enrolment requirements	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.
Learning outcomes	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.
Syllabus	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.
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Class attendance and taking partial and final exams.

Monitoring student work

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

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, 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</td></tr>
</table>

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

Subject name	IT Project – Database						
ID		Study year	2.				
Lecturer	doc. dr. sc. Monika Mladenović	Points value (ECTS)	2.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			0	30	0	0	
Subject status	Compulsory	Online percentage	0%				
Subject description							
Subject goals	The course combines theoretical and practical components in the field of relational database design, focusing on real-world application through a student project.						
Enrolment requirements	Admission requirements: Enrollment in the course Databases. Entry competences: Basic user-level proficiency in operating systems; familiarity with key concepts of the relational data model.						
Learning outcomes	Upon successful completion of the course, the student will be able to: 1. Evaluate the feasibility of a relational database project. 2. Design a relational model for simpler real-world problems described in natural language. 3. Construct an Entity-Relationship (ER) model. 4. Develop a database based on the ER model. 5. Formulate and execute queries on the database. 6. Develop an application layer for interacting with the database. 7. Assess and evaluate the data model.						
Syllabus	Basic concepts of relational databases. (2) System analysis. (2) System design. (2) Design of the ER model. (2) Mapping the ER model to the relational data model. (2) Implementation of the relational database. (2) Project tasks and analysis of representative examples. (2) Work on the project. (12) Presentation of completed projects. (4)						
Teaching types	☐ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐				
Student obligations	Lessons attendance, homeworks, activity on lessons						
Monitoring student work	Class attendance	0.5	Research		Practical work		
	Experimental work		Paper				
	Essay		Seminar paper				
	Colloquiums		Oral exam				

	Written exam		Project	1.5		
Assessment and evaluation of student work	Activity of students in lectures and exercises (presence at the exercises and work on project) (25%) Final project (75%) The final grade is derived on the basis of all these ratings with weighting factors as indicated in parentheses for each form of assessment					
Required literature	Title	Number of copies available		Availability on other medium		
	–					
Supplementary literature						
Quality assurance	Talk with students, student evaluation using the anonymous survey, the success of students in the exam, self-assessment.					
Other (in the opinion of the proponent)						

<table>
<tr><td>Subject name</td><td colspan="6">Human Computer Interaction:: Fundamentals and Principles</td></tr>
<tr><td>ID</td><td>PMIH30</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Andrina Granić</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">25%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Acquisition of fundamental knowledge related to the interaction between human and computer, the importance of good user interface design, along with its role in effective communication between humans and interactive computer systems. Introduction to basic aspects and principles of usable and accessible design as well as design for good user experience. Acquisition of knowledge related to techniques and methods of usability and user experience evaluation.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">No formal prerequisites, but is assumed that students have already acquired basic knowledge about interactive computer systems</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Name and explain fundamental terminology and concepts from the Human-Computer (HCI) field.
2. Critically evaluate selection of the principles for the design of usable and accessible user interface.
3. Explain the design for good user experience.
4. Compare and value different approaches to usability evaluation.
5. Decide on adequate methodology for user interface evaluation.
6. Use case: critically evaluate reasons for the development of interactive computer system (product, service); decide on the key functionality according to the set goals; apply principles of usable interface design; decide on and employ adequate evaluation approach.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures:
1. Human-Computer Interaction (HCI): definitions and fundamental principles (2h)
2. Design of everyday things (2h)
3. Usability, accessibility and user experience (2h)
4. Short chronology on interface and interaction design (2h)
5. Human aspects of interaction (4h)
6. Modelling of human-computer interaction (2h)
7. Computer aspects of interaction (2h)
8. Invited lecture (2h)
9. Development of interactive computer systems (2h)
10. User interface design (2h)
11. Prototyping (2h)
12. User interface evaluation (4h)
13. Future interfaces and interactions (2h)
Exercises:
1. Introduction to course exercises - generally about structure of exercises; gained knowledge and skills; topics which will be covered; work flow; individual and group tasks; grading.
2. Psychology of everyday things - examples of usable and unusable design of everyday things; analysis of unnecessary design, design with potential and design with new purpose; emotional design; design of future
things; 1. Individual task for students (analysis of everyday things, usable and unusable design).
3. Presentations of the 1. Individual student tasks - analysis and discussion.</td></tr>
</table>

<table>
<tr><td></td><td>4. Role of the cognitive psychology – area of interest, influence on the Human Computer Interaction field; information processing; Model of Human Processor; user interface perception.
5. Cognitive “lab” – practical exercises in solving problems from the field of cognitive abilities (attention, perception, memory, learning, problem solving).
6. User interface usability – examples of web interfaces; usability testing methodology; 2. Individual task for students (interface usability analysis of the 3 web sites).
7. Presentations of the 2. Individual student tasks – analysis and discussion.
8. Introduction to group project – iteration procedure of designing web site interfaces; usability testing introduction; goal and methods; task description for preparing and conducting the testing; instructions for writing an usability report.
9. Allocation of tasks and web site interface for usability testing – group work.
10. Developing measurement instruments, questionnaires and questions for user interviews – group work.
11. Implementation of interface usability testing through 6 steps – group work.
12. Group presentations of conducted testing – analysis and discussion.
13. Defining necessary changes on web site interfaces – group work.
14. Implementation of necessary changes on web site interfaces – group work.
15. Group projects – final presentations of student projects.</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>Active participation in all activities: lectures, consultations, searching the literature, individual work in the assigned project and given use case; final oral exam</td></tr>
<tr><td>Monitoring student work</td><td><table>
<tr><td>Class attendance</td><td>1</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</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>Individual /group projects (50%).
Final/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>J. Preece, et al.: Human-Computer Interaction, Addison-Wesley, Harlow, England, 1994.</td><td>1</td><td></td></tr>
<tr><td>B. Schneiderman and C. Plaisant: Designing the User Interface. Strategies for Effective Human-Computer Interaction, 5th Edition, Addison-Wesley, Reading, MA, 2010.</td><td>1</td><td>on-line</td></tr>
</table></td></tr>
<tr><td>Supplementary literature</td><td>1. S. Krug: Don't Make Me Think, Revisited: A Common Sense Approach to Web Usability. 3rd Edition, New Riders, 2014.

2. J. Nielsen: Usability Engineering, Boston: AP Professional, 1993.</td></tr>
</table>

	3. D. Norman: The Psychology of Everyday Things, Basic Books, 1988. Svi nastavni materijali dostupni on-line, uključujući i dodatnu znanstvenu literaturu.
Quality assurance	student discussion, anonymous student evaluation questionnaire, student success rate, self-assessment
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. 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.						
Syllabus	1. Definition of research problems. 2. Literature research. 3. Data collection and preparation. 4. Data analysis. 5. Presentation of research results. 6. Writing seminars.						
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	izv. prof. 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	Availability on other medium

		copies available	
	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)			

Subject name	Research in Biophysics		
ID	PMP407	Study year	2.
Lecturer	doc. dr. sc. Lucija Krce	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 10, S: 20, E: 0, P: 0
Subject status	Compulsory	Online percentage	20%

Subject description

Subject goals	To train students towards independent research, with the participating in development, measurement, analysis and presentation of scientific projects in biophysics and bio-science.
Enrolment requirements	The learning outcomes of Bachelor programmes in physics, basic knowledge in molecular biology and biochemistry.
Learning outcomes	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.
Syllabus	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
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring ☑ Aktivni rad studenata, uz stručno vođenje. ☐ ☐ ☐
Student obligations	Independently, with the professional guidance, to complete and present small scientific project.

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			

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">Preparation and presentation of the research (100%).</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>Depending on the choice of the research subject</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3"></td></tr>
<tr><td>Quality assurance</td><td colspan="3">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.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

Subject name	Research in Environmental Physics						
ID	PMP26C	Study year	2.				
Lecturer	izv. prof. dr. sc. Žarko Kovač izv. prof. dr. sc. Jadranka Šepić	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			10	20	30	0	
Subject status	Compulsory	Online percentage	0%				
Subject description							
Subject goals	– train students for independent research – acquire skills of presentation of scientific results according to the standards of the profession – encouraging independent research						
Enrolment requirements	– Introduction to Fluid Mechanics – Meteorology I – Ocean Physics I – Introduction to Data Analysis – Meteorology II – Ocean Physics II						
Learning outcomes	– 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						
Syllabus	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 (*) 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.						
Teaching types	☑ Lectures ☑ Seminars	☑ Fieldwork ☑ Individual assignments	☑ Homework				

<table>
<tr><td></td><td colspan="6">☑ Exercises
☐ Fully online
☑ Combined online</td><td colspan="6">☑ Multimedia
☑ Laboratory
☑ Mentoring</td><td>☐
☐
☐</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>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: 5, S: 15, E: 0, P: 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)	

Subject name	Research in Computer Science Education						
ID	PMIK65	Study year	2.				
Lecturer	doc. dr. sc. Monika Mladenović	Points value (ECTS)	5.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			15	30	0	0	
Subject status	Compulsory	Online percentage	0%				

Subject description

Subject goals	Explore literature for selected areas of IT education research (eg teaching methods, visualization systems, educational technology, etc.), write a literature review for the selected area, and create a research plan.
Enrolment requirements	Completed Method of teaching computer science II
Learning outcomes	After passing the course, students will be able to: – Discuss areas of information education and open research issues – Describe the steps in carrying out the literature review – Recognize scientific papers that are relevant to the implementation of their own research work – Identify research questions, applied methodology and research findings – Create an overview of the area – Develop a plan for carrying out its own research – Discuss the decisions made in the design of the research plan
Syllabus	1. Getting acquainted with the areas of research in informatics education (2 + 0) 2. Research Planning Phases (2 + 0) 3. Examples and analysis of existing research in education from selected IT fields (7 + 0) 4. How to write literature review (2 + 0) 5. Analysis of Existing Literary Examinations (2 + 0) 6. Presentations of student seminars and research plans (0 + 15)
Teaching types	[x] Lectures [x] Seminars [ ] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [ ] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring
Student obligations	Attending lectures. Creating seminar work. Design (and conduct) research

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

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">Research plan (30%), seminar work and presentation (70%).</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>Sally Fincher, Marian Petre: Computer Science Education Research, 2004.</td><td>1</td><td></td></tr>
<tr><td>Orit Hazzan, Tami Lapidot, Noa Ragonis: Guide to Teaching Computer Science: An Activity-Based Approach</td><td>1</td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">Journals. Computers & Education, ACM Transactions on Computing Education The Computer Science Education
Copnferences: SIGCSE (Special Interest Group on Computer Science Education) ITiCSE (Innovation and Technology in Computer Science) ISSEP (Informatics in Secondary Schools: Evolution and Perspective)</td></tr>
<tr><td>Quality assurance</td><td colspan="3">Conversation with students, student evaluation using anonymous poll, student success on exams, self-assessment,</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

Subject name	Isolation and Application of Essential Oils		
ID	PPB264	Study year	3.
Lecturer	prof. dr. sc. Valerija Dunkić	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 the characteristics of wild plants the rich secondary metabolites mainly essential oils, and their isolation, analysis and chemical composition
Enrolment requirements	Passed the examination of the General Botany or Botany
Learning outcomes	Student will be able to: 1. Describe the structure and function of secondary metabolites in the aromatic herbs 2. Identify the different essential oils chemotype 3. Know the development and application of essential oils 4. To appreciate the importance of using natural herbal products 5. Understanding and application of acquired knowledge about the importance of ecologically clean plants and products on to human health.
Syllabus	Lectures: / Exercises: 1. Characteristics of xerophytes. CAM – photosynthesis 2. Specific properties of the vegetative organ 3. Surface protection and defence material, secondary metabolites. 4. Essential oils and glycosides of isolation, analysis and biological role. 5. Special emphasis on plants from the Lamiaceae family, with the determination of habitat conditions 6. Glycosides, alkaloids, tannins, vitamins, minerals; an overview of aromatic plants, collection, identification and drying of plant material 7. Methods of isolation of secondary metabolites; GC / MS and GC / FID methods 8. Analysis and identification of chemical components of isolated secondary metabolites; Application of isolated secondary metabolites.
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☑ Fieldwork ☐ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring
Student obligations	70% attendance at lectures 100% completed laboratory exercises and described an aromatic plant species

Monitoring student work

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

	Written exam		Project			
Assessment and evaluation of student work	Fully completed laboratory exercises, presentation and oral exam					

Required literature	Title	Number of copies available	Availability on other medium
	Adams, R.P. Identification of essential oil components by gas chromatography/ mass spectroscopy. Fourth ed. Allured Publishing Corp.: Carol Stream IL, USA		
	Taiz, L. and Zeiger, E. (2002): Plant Physiology. Sinnauer Ass. Inc. Sunderland, Massachusetts		
	Buchanan, B., Gruissem, W., and Jones, R. L. (2002): Biochemistry and Molecular Biology of Plants. John Wiley & Sons. Stryer, L. (1991)		

Supplementary literature	
Quality assurance	Methods Quality assurance will be performed at three levels: (1) University Level, (2) Faculty Level by the Commission for Quality Control, (3) Teaching Level
Other (in the opinion of the proponent)	

Subject name	Carcinogenesis and Mutagenesis						
ID	PMB714	Study year	2.				
Lecturer	doc. Mirjana Babić Leko	Points value (ECTS)	3.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			20	10	0	0	
Subject status	Compulsory	Online percentage	0%				

Subject description	
Subject goals	The goal of the course is to introduce students of the graduate study of Molecular Biology to the molecular mechanisms of the formation and development of tumors, with the goal of understanding personalized therapy. Emphasis is placed on cell signaling in cancer, which is crucial in the field of medical oncology. The course presents a new treatment concept that has been intensively developed in the biomedical sciences for the past 20 years. Accordingly, students will be able to delve deeper into the issue of carcinogenesis both for research purposes and in clinical practice.
Enrolment requirements	1) Biochemistry 2) Genetics 3) Molecular biology
Learning outcomes	The students are expected to: 1. Acquire an overview of the most important signaling pathways in carcinogenesis. 2. Become familiar with the effect of targeted therapy on the components of cellular signaling pathways in the cell for treatment purposes. 3. Recommend targeted therapy or a combination of the same. 4. Be familiar with the possible mechanisms of resistance caused by a newly formed mutation in tumor cells; "follow-up care".
Syllabus	Lectures (20 hours) 1. Introduction to carcinogenesis and mutagenesis. Definition and classification of tumors. Main characteristics of malignant tumors. (1 hour) 2. Genetic instabilities and changes in the genome during carcinogenesis. Mechanisms of DNA repair. Mutagens and carcinogens. Treatment strategies targeting DNA repair pathways. (2 hours) 3. Regulation of gene expression during carcinogenesis. Epigenetic changes during carcinogenesis. Telomeres and telomerase in carcinogenesis. MicroRNA (miRNA) molecules and regulation of mRNA expression. Treatment strategies related to the mentioned mechanisms. (1 hour) 4. Signaling by growth factors and oncogenes. Mechanisms of oncogenic gene activation. Oncogene-targeted treatment strategies (with emphasis on Gleevec and Herceptin). (2 hours) 5. Growth inhibition and tumor suppressor genes. Rb gene and p53 gene. Mechanisms of tumor suppressor gene loss of function. Interaction of viral protein products with Rb and p53. Treatment strategies targeting tumor suppressors. (2 hours) 6. Control of the cell cycle - phases of the cell cycle. Cyclins and cyclin-dependent kinases and their regulation. Passage of the cell through cell cycle checkpoints. Therapeutic strategies targeting cell cycle components. (2 hours) 7. Apoptosis in carcinogenesis. Apoptosis and chemotherapy. Treatment strategies aimed at triggering apoptosis in tumor cells. (2 hours) 8. Stem cells and differentiation. Cancer stem cells. Therapeutic strategies. (1 hour) 9. Metastases. Metastasis process. Tools of cell invasion: cell adhesion molecules, integrins and proteases. Epithelial-mesenchymal transition. Angiogenesis. Treatment strategies aimed at targeting metastasis and angiogenesis. (2 hours) 10. Immune system, infections and inflammation in carcinogenesis. The tumor suppressive role of the immune system. Immunoediting of cancer. Infectious and non-infectious agents as carcinogens. NF-κB. Therapeutic strategies. (2 hours) 11. Nutrients, hormones and gene interactions in carcinogenesis. Nutrition; causative and preventive factors. Reprogramming of energy metabolism in tumor cells. Hormones and cancer. (1 hour)

	12. Cancer industry: drug development, pharmacogenomics and clinical trial design. (1 hour) 13. Carcinogenesis research in the future: focus on cancer vaccines and new technologies. (1 hour) Seminars (10 hours) The seminars will be conducted in the form of a Journal Club. Students will have to choose scientific articles that are within the scope of this course and that cover the latest achievements in cancer research. Students will present their work in front of other students (in the form of a PowerPoint presentation, 10–15 minutes), and other students will participate in a discussion on the topic of the presented seminar work.				
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	1	
	Colloquiums		Oral exam		
	Written exam	1.5	Project		
Assessment and evaluation of student work	Class attendance, evaluation of student seminars, as well as the results of the written test are included in the overall final grade.				
Supplementary literature	Geoffrey M. Cooper (2019): The Cell: A Molecular Approach. Eight edition. ASM Press.				
Quality assurance	The successful implementation of the course will be assessed through active interaction with students during lectures and seminars, by performing an internal survey and a survey conducted according to the regulations of the University of Split, and through statistical analysis of the exam results.				
Other (in the opinion of the proponent)					

Required literature:

Title	Number of copies available	Availability on other medium
Lauren Pecorino (2021): Molecular Biology of Cancer: Mechanisms, Targets, and Therapeutics. Oxford University Press.		

Subject name	The chemistry of fragrances and perfumes		
ID	PMC321	Study year	3.
Lecturer	doc. dr. sc. Marina Kranjac	Points value (ECTS)	2.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 0, P: 0
Subject status	Elective	Online percentage	0%
Subject description			
Subject goals	Gaining fundamental knowledge of the chemistry of fragrances and perfumes. Understanding the methods for isolating of odoriferous ingridients from natural sources, with a particular focus on those relevant to perfumery.		
Enrolment requirements	Students must have a fundamental knowledge of organic chemistry, including the representation of chemical structures of organic compounds, the main classes (groups) of organic compounds and functional groups, the basic properties of organic compounds and the common types of chemical reactions in organic chemistry.		
Learning outcomes	After completing the course “The Chemistry of Fragrances and Perfumes“, students should be able to - define basic terms in the chemistry of fragrances and perfumes - list the most common natural perfumery ingredients - propose, select and describe a suitable method for the isolation of fragrances of plant and animal origin - classify odorants and give examples and characteristic structures of representative synthetic and natural odorants		
Syllabus	Week 1: Introduction to the course (content of the course, criteria and conditions for admission). Definitions of the basic terms: fragrance, odorant, odor threshold, odor activity value. Week 2: The chemical sense. The olfactory system. Perfumes. Volatility and other properties of odorants. Week 3: The history of fragrances, chemical discoveries and modern perfumery. Fragrance as an art and science. Week 4: Classification and characteristics of odoriferous products. Extrait Parfum, Eau de Parfum formulation, Eau de Toilette, Eau de Cologne and others. Week 5: Classification of odors based on the source of ingredients (natural, nature-identical and synthetic) and odor description (olfactory families). Week 6: Odor structure. Examples of most significant perfumes. Week 7: Classification of ingredients of natural origin. Methods of isolation of natural perfumery ingredients (essential oil, concrete, pommade, resinoid, absoulte, tincture) Week 8: Perfumery materials of natural origin. Botanical sources (different parts of plants: green parts, bark, flowers, fruits). Examples and structures of representative odorants. Week 9: Perfumery materials of natural origin. Plant sources (different parts of plants: green parts, roots, rhizomes, seeds, wood and others) Examples and structures of representative odorants. Week 10: Perfumery materials of natural origin. Animal sources. Other sources and natural materials. Examples and structures of representative odorants. Week 11: Synthetic odorants. Classification of odorants. Week 12: Structure-odor relationships. Week 13: Enantioselectivity of odor Sensation. Chiral odorants. Week 14: The safety and toxicology of fragrances. Skin irritation. Skin Sensitisation. Photoeffects. Neurotoxicity and other effects. Week 15: Fragrance analysis of natural products: the headspace approach. Basic principles of the method. Examples of headspace		

	chromatograms.
Teaching types	✓ Lectures ✓ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ✓ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Students are obliged to attend classes regularly.

Monitoring student work

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

Assessment and evaluation of student work	Students work in class will be evaluated through monitoring their activity and participation in the learning process, as well as success in the final oral exam.

Required literature

Title	Number of copies available	Availability on other medium
–		

Supplementary literature	Scent and Chemistry: The Molecular World of Odors, 2nd Edition, Günther Ohloff, Wilhelm Pickenhagen, Philip Kraft, Fanny Grau, WILEY-VCH, 2022 The Chemsitry of Fragrances From Perfumer to Comsumer,2nd Edition, Ed. C. Sell, RSC Publishing, 2006
Quality assurance	Quality of teaching and learning is monitored at the level of (1) teachers, by accepting suggestions from students, and (2) the University and/or Faculty, through conducting student surveys on teaching quality.
Other (in the opinion of the proponent)	

Subject name	Kinesiological activity, fitness and health					
ID	PMS135	Study year	1.			
Lecturer	prof. dr. sc. Mladen Hraste	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	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					
Enrolment requirements	There are no requirements for subject enrolling. There are no entry competences required.					
Learning outcomes	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					
Syllabus	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) 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 copies available	Availability on 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)	

<table>
<tr><td>Subject name</td><td colspan="3">Clasical Mechanics</td></tr>
<tr><td>ID</td><td>PMP116</td><td>Study year</td><td>3.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Željana Bonačić Lošić</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>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">Develop the student commpentences in theoretical mechanics that are useful for further studies and application in their area of expertise.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3"></td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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.</td></tr>
<tr><td>Syllabus</td><td colspan="3">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.</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: 3; Research: ; Practical work:
Experimental work: ; Paper:
Essay: ; Seminar paper:
Colloquiums: ; Oral exam: 3
Written exam: 2; Project: </td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">Preliminary exams. Written exam. Oral exams.</td></tr>
<tr><td>Required literature</td><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
</table>

	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)			

Subject name	Classical Mechanics I		
ID	PMP110	Study year	2.
Lecturer	izv. prof. dr. sc. Željka Sanader Maršić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 45, S: 0, E: 30, P: 0
Subject status	Compulsory	Online percentage	30%
Subject description			
Subject goals	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.		
Enrolment requirements	Mechanics (passed) Mathematics I (passed) Mathematics II (attended)		
Learning outcomes	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).		
Syllabus	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 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	☑ 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 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.
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</td></tr>
</table>

	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)	

Subject name	Klimatske promjene, meteorologija i oceanografija u nastavi		
ID	PMF5	Study year	1.
Lecturer	izv. prof. dr. sc. Jadranka Šepić	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 15, S: 0, E: 0, P: 0
Subject status	Elective	Online percentage	0%

Subject description

Subject goals	Upoznati se s teorijskim osnovama odabranih poglavlja iz područja klimatskih promjena, meteorologije i oceanografije. Osmisliti nastavni sadržaj, s uključenom teorijskom, eksperimentalnom i istraživačkom komponentom, vezan uz odabranu temu
Enrolment requirements	
Learning outcomes	Po završetku kolegija studenti će moći: ➢ Samostalno obrađivati teme iz klimatskih promjena, meteorologije i oceanografije ➢ Osmisliti i razviti teorijsku komponentu nastavnog sadržaja ➢ Osmisliti i razviti eksperimentalnu komponentu nastavnog sadržaja ➢ Osmisliti i razviti istraživačku komponentu nastavnog sadržaja
Syllabus	1. Upoznavanje s odabranom temom iz područja klimatskih promjena, meteorologije i oceanografije (4 h) 2. Demonstracijski eksperimenti vezani uz odabranu temu; te njihovo osmišljavanje i provođenje (4 h) 3. Osmišljavanje istraživačkog rada prikladnog za rad s učenicima (4 h) 4. Osmišljavanje i razvoj cjelokupnog nastavnog sadržaja vezanog uz odabranu temu (4 h)
Teaching types	☑ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Pohađanje nastave, seminarski i istraživački rad

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

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3"></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>John Marshall & R. Alan Plumb Atmosphere, Ocean and Climate Dynamics Elsevier Academic Press, 2008.</td><td>1</td><td></td></tr>
<tr><td>J. David Neelin Climate Change and Climate Modelling</td><td>1</td><td></td></tr>
<tr><td>Practical Meteorology: An algebra-based survey of Atmospheric Science Kluwer, 1988.</td><td>1</td><td></td></tr>
<tr><td>Egbert Boeker & Rienk Van Grondelle Environmental Physics: Sustainable Energy and Climate Change Wiley</td><td>1</td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3"></td></tr>
<tr><td>Quality assurance</td><td colspan="3">Razgovori sa studentima, anonimna studentska anketa, uspješnost na ispitu,
samoanaliza.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="3"></td></tr>
</table>

Subject name	Climate System		
ID	PMP169	Study year	2.
Lecturer	izv. prof. dr. sc. Jadranka Šepić dr. sc. Natalija Dunić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 35 S: 0 E: 30 P: 0
Subject status	Compulsory	Online percentage	30%
Subject description			
Subject goals	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.		
Enrolment requirements	– Meteorology I – Ocean Physics I – Introduction to Data Analysis – Meteorology II – Ocean Physics II		
Learning outcomes	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.		
Syllabus	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) 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	☐ Fieldwork ☑ Individual assignments	☐ ☐

	☑ Exercises ☐ Fully online ☑ Combined online		☐ 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)	

Subject name	Cognitive psychology					
ID	PMS174	Study year	2.			
Lecturer	doc. dr. sc. Nikola Marangunić	Points value (ECTS)	4.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			15	15	15	0
Subject status	Elective	Online percentage	0%			

Subject description	
Subject goals	Understanding basic psychology concepts of learning, memory, perception and intelligence. Introducing theoretical and practical fundament of acquiring knowledge and problem solving.
Enrolment requirements	None
Learning outcomes	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.
Syllabus	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.
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☑ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Attending and activity in classes, individual tasks, work on the project, project presentation.

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	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)	

<table>
<tr><td>Subject name</td><td colspan="3">Cognitive psychology</td></tr>
<tr><td>ID</td><td>PMS174</td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Nikola Marangunić</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: 15, 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">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="3">None</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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="3">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>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">Attending and activity in classes, individual tasks, work on the project, project presentation.</td></tr>
</table>

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	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	Complex analysis		
ID	PMM116	Study year	3.
Lecturer	prof. dr. sc. Jurica Perić	Points value (ECTS)	6.0
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	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.		
Enrolment requirements	Taken course „Foundation of mathematical analysis“.		
Learning outcomes	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		
Syllabus	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		
Teaching types	[x] Lectures [ ] Seminars [x] Exercises [ ] Fully online [ ] Combined online	[ ] Fieldwork [ ] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring	[ ] [ ] [ ] [ ]

<table>
<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>

Subject name	Communication Skills		
ID	PMSN09	Study year	1.
Lecturer	Ana Mršić Zdilar, v. 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	• 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.		
Enrolment requirements	None.		
Learning outcomes	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		
Syllabus	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		
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)						

Subject name	Cryptography		
ID	PMM205	Study year	2.
Lecturer	prof. dr. sc. Borka Jadrijević	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 15, E: 15, P: 0
Subject status	Elective	Online percentage	40%

Subject description

Subject goals	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.
Enrolment requirements	Completed course: Introduction to number theory
Learning outcomes	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.
Syllabus	- 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)
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ 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)						

<table>
<tr><td>Subject name</td><td colspan="6">Quantum Physics</td></tr>
<tr><td>ID</td><td>PMP117</td><td>Study year</td><td colspan="4">3.</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>40</td><td>15</td><td>30</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 teach students basic concepts in quantum mechanics and their
application to simple problems and hydrogen atom.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Learning outcomes in general physics, classical mechanics, linear algebra and differential equations.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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.</td></tr>
<tr><td>Syllabus</td><td colspan="6">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)</td></tr>
</table>

	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
Presentations from lectures		Moodle, Web 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)	

Subject name	Linear Algebra I		
ID	PMM153	Study year	1.
Lecturer	doc. dr. sc. Tea Martinić Bilać	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	15%
Subject description			
Subject goals	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.		
Enrolment requirements	Prerequisites: none Entry competences: Knowledge of secondary school mathematics		
Learning outcomes	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.		
Syllabus	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) –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

Title	Number of copies available	Availability on 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)	

<table>
<tr><td>Subject name</td><td colspan="6">Linear algebra II</td></tr>
<tr><td>ID</td><td>PMM154</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Borka Jadrijević</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">Presentation of a standard undergraduate Linear algebra course material in a way
which helps students to master subjects like linear maps, matrices, determinants,
eigenvalues and eigenvectors, Gaussian reduction etc. The course focuses both on
theory and on calculating using a developmental approach. Many carefully chosen
examples serve to emphasize motivation and naturalness.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">An acquaintance with the algebraic structure of vector space gained from a one semester introductory mathematical course.
In internal case: taken course "Linear Algebra I'.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon successful completion of the course student should
1) understand why it suffices to define a linear map on a basis of the vector
space (v.s. for short);
2) gain skills in matrix calculus and in evaluating determinants;
3) be able to associate a matrix with a linear transformation with respect to
different bases and understand the relationship between two such matrices;
4) distinguish consistent from inconsistent linear systems of equation;
5) be able to effectively solve a system of linear equations with several
unknowns using different methods/algorithms;
6) recognize an eigenvalue problem and be able to compute eigenvalues and
eigenvectors;
7) be able to find the Jordan canonical form of a matrix;
8) understand in what way both an inner product and a norm enrich the
structure of v.s.;
9) be able to construct an orthonormal basis by means of the Gram-Schmidt
orthonormalization process.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Linear maps, examples. Isomorphism of vector spaces. (3 hours)
2. Dimension characterizes an isomorphism class. Rank and nullity of a linear
map. Algebraic structure of the sets Hom(U,V) and HomV. (3 hours)
3. Dimension of Hom(U,V). Linear functional, examples. Dual space.
Isomorphism of v.s. and its second dual. (3 hours)
4. V.s. Mmxn and algebra Mn. General linear group. Orthogonal group. (3
hours)
5. Rank of a matrix. Elementary transformations. Determinant. Binet-Cauchy
theorem. (3 hours)
6. Laplace's expansion. Adjoint matrix. Coordinatization of v.s. and</td></tr>
</table>

	transformation of coordinates. (3 hours) 7. Representing linear maps (transformations) with matrices. Characteristic and minimal polynomial. Hamilton-Cayley theorem. (3 hours) 8. Invariant subspace. Eigenvalue and the associated eigenspace. (3 hours) 9. Diagonalizability of a matrix (a transformation); Jordan canonical form. System of linear equations - the notion and consistency problem. (3 hours) 10. Cramer's rule. Description of the solution set to a (non)homogeneous system of linear equations. Elementary reduction operations on system equations (matrix rows). (3 hours) 11. Gauss's method. Inner product space; examples. Cauchy-Schwarz inequality. (3 hours) 12. Norm on inner product space, angle, orthogonality. Gram matrix. Gram Schmidt orthonormalization process. (3 hours) 13. Fourier coefficients. Calculation in an orthonormal basis. Orthogonal complement. Orthogonal projection. (3 hours) 14. Unitary maps preserving inner product, examples and properties. Characterizations of a unitary map (without proof). Unitary group. (3 hours) 15. Some additional properties of a unitary map. Diagonalizability of a unitary and orthogonal transformation. Orthogonal transformations of R3 . (2 hours)
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	Lectures and exercises

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	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)	

Subject name	Macrozoobenthos of the Karst Streams		
ID	PPB266	Study year	3.
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%

L	S	E	P
15	15	0	0

Subject description

Subject goals	– 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
Enrolment requirements	None
Learning outcomes	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
Syllabus	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
Teaching types	[x] Lectures [x] Seminars [ ] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [ ] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring [ ] [ ] [ ] [ ]
Student obligations	– prema pravilniku o studiranju

Monitoring student work

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

<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">Oral exam and seminar presentation</td></tr>
<tr><td rowspan="8">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">Paul S. Giller and Björn Malmqvist (1999) The Biology of Streams and Rivers</td><td></td><td></td></tr>
<tr><td colspan="4">Ivo Matoničkin, Zlatko Pavletić (1972) ŽIVOT NAŠIH RIJEKA: Biologija tekućih voda</td><td></td><td></td></tr>
<tr><td colspan="4">Campaioli, S., Ghetti, P.F., Minelli, A., Ruffo, S. (1994): Manuale per il riconoscimento dei macroinvertebrati delle acque dolci Italiane. Von Trento. Vol. I</td><td></td><td></td></tr>
<tr><td colspan="4">Campaioli, S., Ghetti, P.F., Minelli, A., Ruffo, S. (1999): Manuale per il riconoscimento dei macroinvertebrati delle acque dolci Italiane. Von Trento. Vol. II</td><td></td><td></td></tr>
<tr><td colspan="4">Erben, R., Leiner, S. (1997): Vode tekućice i njihov živi svijet II. Hrvatska vodoprivreda.</td><td></td><td></td></tr>
<tr><td colspan="4">Giller P. S., Malmquist, B. (1998): The biology of streams and rivers. Oxford University Press, Oxford.</td><td></td><td></td></tr>
<tr><td colspan="4">Kerovec, M. (1986): Priručnik za upoznavanje beskralježnjaka naših potoka i rijeka. Sveučilišna naklada Liber, Zagreb.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">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</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">Mathematical Logic</td></tr>
<tr><td>ID</td><td>PMM110</td><td>Study year</td><td>2.</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: 0
E: 30
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">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="3">Entry competences: elementary set theory.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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="3">- Introduction: historical overview (1)
- Propositional Logic: syntax and semantics (2)
- Normal forms (2)
- Validity tests (1)
- Propositional Calculus (2)
- 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)</td></tr>
</table>

	– Tableau (2) – Predicate Calculus (1) – Metatheorems for first order theories (2) – The Completeness Theorem and consequences (1) – First order theories: examples (4)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☑ 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)
- 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)</td></tr>
</table>

	– 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		
Evaluation elements	Performance (min)	Weight in grade (%)
partial written exams	50	50
problem sets	50	20

Final assessment		
Evaluation elements	Performance (min)	Weight in grade (%)
oral exam	50	30

Required literature	Title	Number of	Availability on other medium

		copies available	
	J. Martin, Introduction to Languages and the Theory of Computation, McGraw Hill, 2010		e-learning
	M. Sipser, Introduction to the Theory of Computation, PWS Publishing Company, 1996.		e-learning
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: 45, S: 15, E: 30, P: 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) 13. Statistical estimation of parameters. Testing statistical hypothesis. (10h)		
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		Independent work and exam	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
	1. L. Vranješ Makrić, Skripta iz matematičkih metoda fizike I, lecture notes, 2009. Moodle Web page		yes
	2. PP Presentations in probability and statistics		yes
Supplementary literature	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.		
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)			

Subject name	Mathematical Methods of Physics II		
ID	PMP101	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: 0, E: 30, P: 0
Subject status	Compulsory	Online percentage	0%

Subject description	
Subject goals	The understanding and the ability to apply appropriate mathematical methods to analyze and solve physical problems.
Enrolment requirements	Mathematics I and Mathematics II.
Learning outcomes	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.
Syllabus	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).

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 available	Availability on other medium
	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 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	☐ Fieldwork ☑ Individual assignments ☐ Multimedia	☐ ☐ ☐

	☐ Fully online ☐ Combined online	☐ 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">Mathematics</td></tr>
<tr><td>ID</td><td>PMMN01</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>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>Compulsory</td><td>Online percentage</td><td>35%</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 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.</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:
• 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.</td></tr>
<tr><td>Syllabus</td><td colspan="3">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)</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>
<tr><td>Monitoring student work</td><td colspan="3">
<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>
</table>
</td></tr>
</table>

	Written exam	2	Project				
Assessment and evaluation of student work	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.						
Required literature	Title					Number of copies available	Availability on other medium
	P. Javor, Uvod u matematičku analizu, Školska knjiga, Zagreb, 1993.						
	Bradić, Pečarić, i ost., Matematika za tehnološke fakultete, Element, Zagreb. 1998.						
	P.P. Demidovič, Zadaci i riješeni primjeri iz više matematike, Zagreb, 1990.						
	T. Vučičić, Matematika (za biologe,...), skripta, PMF, Split						
Supplementary literature	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/						
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	MATHEMATICS I		
ID	PMM005	Study year	1.
Lecturer	dr. sc. Ana Laštre, pred. prof. dr. sc. Josipa Barić	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	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)		

<table>
<tr><td></td><td colspan="6">Newton-Leibniz formula, fundamental theorems of integral calculus (2 hours)
Improper integrals (2 hours)
Applications of integration (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 and partial written exams.</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></td><td>Oral exam</td><td>2</td><td></td><td></td></tr>
<tr><td>Written exam</td><td>3</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="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">I. Slapničar, Matematika 1, skripta, FESB, Split, 2002.</td><td></td><td>http://lavica.fesb.hr/mat1/</td></tr>
<tr><td colspan="4">I. Slapničar, Matematika 2, skripta, FESB, Split, 2008.</td><td></td><td>http://lavica.fesb.hr/mat2/</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">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.</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>

Subject name	Mathematics I		
ID	PMM851	Study year	1.
Lecturer	prof. dr. sc. Josipa Barić	Points value (ECTS)	7.0
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	Focus on intuitive presentation of mathematical theory and on illustrative examples in order to prepare students for future courses.
Enrolment requirements	None
Learning outcomes	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 .
Syllabus	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)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Students are expected to be present for every lecture and exercise section.

Monitoring student work

Class attendance	3	Research		Practical work	
Experimental work		Paper			
Essay		Seminar paper			
Colloquiums	4	Oral exam			

	Written exam		Project			

Assessment and evaluation of student work	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.		
Required literature	Title	Number of copies available	Availability on other medium
	I. Slapničar, Matematika 1, FESB, Split, 2002.		http://lavica.fesb.hr/mat1/
	I. Slapničar, Matematika 2, FESB, Split, 2002.		http://lavica.fesb.hr/mat2/
	B.P. Demidovič, Zadaci i riješeni primjeri iz više matematike, Tehnička knjiga, Zagreb, 1989.	9	
	I. Slapničar, J. Barić, M. Ninčević, Matematika 1 – zbirka zadataka, FESB, Split, 2010.		http://lavica.fesb.hr/mat1/
Supplementary literature	K. Horvatić, Linearna algebra, 9. izdanje, Tehnička knijga, 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 knijga, Zagreb,		
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	Materials		
ID	PMT154	Study year	2.
Lecturer	doc. dr. sc. Ivan Peko	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 45 S: 0 E: 15 P: 0
Subject status	Compulsory	Online percentage	0%
Subject description			
Subject goals	Adopting basic knowledge of materials for the purpose of education in primary and secondary schools		
Enrolment requirements	None		
Learning outcomes	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		
Syllabus	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		
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐
Student obligations	Class attendance, homework (programs), independent study and literature reading, accessing colloquium and/or written and oral examination.		

<table>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>2.5</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>0.5</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>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">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%.</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">Materijali – predavanja (interna skripta) Mr.sc. Goran Fučko</td><td></td><td></td></tr>
<tr><td colspan="4">Deželić R, osnove konstrukcijskih materijala, Fesb, Split</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">Anzulović B., Materijali, FESB, Split</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Conducting an anonymous student surveys, talk with students, analyses the success of students on tests and exams, 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">Medical Physics</td></tr>
<tr><td>ID</td><td>PMP241</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">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>5</td><td>10</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">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="6">Upisan jedan od Diplomskih studija iz prirodnih znanosti</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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="6">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)
Magnetska rezonancija (MRI)
Ultrazvuk
Električni potencijali

Modul 4: Neurofizika
Principi fizike u neuroznanostima
Senzorni sustavi – sluh</td></tr>
</table>

	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)	

Subject name	Mechanics		
ID	PMP001	Study year	2.
Lecturer	prof. dr. sc. Ante Bilušić	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	20%

Subject description	
Subject goals	Understanding the basics of mechanics.
Enrolment requirements	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.
Learning outcomes	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.
Syllabus	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 • (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

<table>
<tr><td></td><td colspan="6">
• (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
</td></tr>
<tr><td>Teaching types</td><td colspan="6">☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online
☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring
☑ Problems solving
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Solving homework assignments during the semester. Class participation.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance</td><td>3.5</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>Problems solving (homeworks)</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>2.5</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">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 colspan="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">Antonije Dulčić: Mehanika, Prirodoslovno-matematički fakultet u Zagrebu, (in Croatian)</td><td>0</td><td>yes (free access)</td></tr>
<tr><td colspan="4">Halliday, Resnick, Walker: Fundamentals of Physics, John Wiley & Sons, 2003.</td><td>25</td><td>yes</td></tr>
<tr><td colspan="4">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 colspan="4">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>
</table>

Supplementary literature	[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
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	Meteorology I		
ID	PMP161	Study year	2.
Lecturer	izv. prof. dr. sc. Jadranka Šepić	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 5, E: 15, P: 0
Subject status	Elective	Online percentage	0%
Subject description			
Subject goals	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		
Enrolment requirements	Basics of physics Basics of mathematics Basics of fluid mechanics Basic programming		
Learning outcomes	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		
Syllabus	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)		
Teaching types	[x] Lectures [ ] Seminars [x] Exercises [ ] Fully online [ ] Combined online	[x] Fieldwork [ ] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring	[x] Homework 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
☐ Fully online
☐ Combined online</td><td colspan="2">☑ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td colspan="3">☑
Homework assignments
☐
☐
☐</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="2">Monitoring student work</td><td colspan="6"><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>1</td></tr></table></td></tr>
</table>

	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)	

Subject name	Physics Education I						
ID	PMP050	Study year	1.				
Lecturer	prof. dr. sc. Mile Dželalija	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	30	30	0	
Subject status	Compulsory	Online percentage	20%				
Subject description							
Subject goals	• To gain knowledge, skills and attitudes required in the field of teaching physics. • To link knowledge in physics with pedagogical knowledge and their methodological aspects. • To deepen understanding of basic physical concepts. • To develop the ability of teaching of physical concepts in an appropriate way for pupil's age and foreknowledge. • To capacitate students in writing lecture plans and teaching lessons in physics in elementary school using different teaching tools and experiments. • To be acquainted with the latest accomplishments in educational physics and to be acquainted with the application of newer and different methods in active learning and teaching.						
Enrolment requirements	• General physics • Pedagogy • Didactics						
Learning outcomes	• To demonstrate knowing and understanding of basic physical laws • To interconnect physics with other subjects • To adduce and explain pupil's most common conceptual and mathematical-logical difficulties in basic physical concepts as well as modes of their solution • To prepare/design, perform and interpret appropriate school experiments • To show knowledge in the usage of professional literature and other relevant information sources for lecture plans • To apply key ideas, models and laws in physics in manners appropriate for pupils • To design, prepare and execute a teaching lesson in elementary school • To apply modern approaches in physics teaching as well as teaching in general • To apply basic elements of scientific reasoning ((hypothetical - deductive reasoning, proportional reasoning, control of variables)						
Syllabus	Lectures (L) - 30 hours: 1. Introduction lesson (introducing students and lecturers, description of work methods, student obligations and assessments of achievements, short description of methodology in physics teaching). 2. Purpose and goals in physics education. Methods and language in physics. Goals and tasks of physics teaching in elementary schools. 3. Knowledge and the nature of science. Didactics of natural sciences. Modeling in physics. 4. Lecture plans for teaching physics. Physics curriculum for elementary school. Learning outcomes. 5. Resources for physics lecture plans in elementary school (methodological handbooks, textbooks, workbooks, web content) 6. Structure of a physics class. Interactive ways of teaching. 7. Phases of cognitive development. Development of formal thinking and gaining of procedural knowledge. Development of mental structures. 8. Physical concepts. Pupil's preconceptions and misconceptions. Conceptual change. 9. Teaching tools for physics classes in elementary school. 10. Role of experiments and observations in a physics class. Hypothetical - deductive reasoning, proportional reasoning, control of variables.						

	11. Problems solving in elementary school (conceptual and numerical problems, representations, nontraditional problems, distractors, test construction). 12. Methods in learning and teaching physics (theory of learning, teaching approaches, teaching strategies). 13. Teaching based on conceptual understanding (constructivism, problem and research based teaching). 14. Planning, preparing and class realization. Preparing a physics class (written lecture plan). 15. Evaluation as a constituent part of teaching physics. Tracking and grading work of pupils. Assessment of teaching efficacy (internal and outer – PISA, TIMSS). Laboratory exercises (LE) – 30 hours: Students prepare experimental setup, run experiments, describe and explain results that will be done by them or their pupils in elementary schools. Seminar and praxis in elementary school (S) – 30 hours: Observing cooperating teacher's lessons, writing lecture plans and giving trial lectures under supervision of cooperating teacher and university teacher.
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☑ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Attendance of at least 80% of lectures and 80% of laboratory exercises. Observing 30 classes in elementary school. Written lecture plans for two lessons and two trial lectures given in elementary school.

Monitoring student work

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

Assessment and evaluation of student work	• class attendance and homeworks – up to 10 points • Written lecture plans – up to 14 points • Two trial lectures given in an elementary school– up to 16 points • notes from the class observations and seminar (analysis and self-analysis) up to 10 points, • written exam – up to 10 points • oral exam – up to 20 points • laboratory exercises – up to 20 points Written exam is consisted of problems (exercises) that are appropriate for 7th and 8th grade physics level. Oral exam is consisted of 5 conceptual questions randomly selected from a pre-given list of questions. Each question is from a different teaching unit. Final grade is given as follows: • 89 – 100 points: excellent • 76 – 88 points: very good • 63 – 75 points: good • 50 – 62 points: sufficient

Required literature

Title	Number of copies available	Availability on other medium

	R. Krsnik, Suvremene ideje u metodici nastave fizike, Školska knjiga, Zagreb, 2008.		
	V. Mešić, Uvod u didaktiku fizike, PMF Univerziteta u Sarajevu, Sarajevo 2015.		
Supplementary literature	B. Arons, Teaching Introductory Physics, John Wiley & Sons Inc. 1996. E. F. Redish, Teaching Physics with the Physics Suite, John Wiley & Sons Inc. 2003		
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)			

<table>
<tr><td>Subject name</td><td colspan="6">Physics Education II</td></tr>
<tr><td>ID</td><td>PMP150</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">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>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 gain knowledge, skills and attitudes required in the field of teaching physics.
• To link knowledge in physics with pedagogical knowledge and their methodological aspects. • To deepen understanding of basic physical concepts.
• To develop the ability of teaching of physical concepts in an appropriate way for pupil’s age and foreknowledge.
• To capacitate students for lecture plan writing and teaching lessons in high school physics using different teaching tools and experiments.
• To be acquainted with the latest accomplishments in educational physics and to be acquainted with the application of newer and different methods in active learning and teaching.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Physics Education I</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">• To be able to use professional literature and other relevant information sources in order to write lecture plans for high school physics
• To adjust old or make new motivating class materials that will enable active learning of all students
• To design, prepare and give a physics lesson in high school
• To construct curricula for elementary and high school physics
• To construct appropriate physical models based on analysis of real problems
• To apply basic experimental techniques and processing of measured data
• To define measurable outcomes of learning in physics classes in accordance with curriculum.
• To apply knowledge in psychology, pedagogy, didactics methodology of teaching physics during class
• To clearly and concisely present complex ideas in physics
• To apply modern technologies during physics class
• To apply special educational activities for gifted pupils (peer contest, teaching outside of classroom, cooperation with the local community and associations that promote interest in physics)</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures (L) – 30 hours:
1. Introduction lesson (introducing students and lecturers, description of work methods, student obligations and evaluations of achievements).
2. Planning and evaluating physics classes. Physics Curricula for high school. Educational outcomes.
3. Resources physics lecture plans in high school (methodological handbooks, textbooks, workbooks, web content).
4. Teaching tools for physics classes in high school.
5. The role of history of physics in teaching high school physics.
6. The role of mathematics and mathematical formalism in the development of physical concepts (pupil’s mathematical-logical difficulties in understanding physics).
7. Usage of photography and sketch in a physics class.
8. Usage of film and animation in a physics class.
9. Usage of computer simulations in a physics class.
10.Usage of informational – communicational technologies in a physics class (Moodle, web applications).
11. Usage of a computer as a measuring device in a physics class (Tracker, Audacity, Oscilloscope).</td></tr>
</table>

	12. Basic computer techniques of gaining, processing and displaying measured data. 13. Educational standards and laws related to elementary and high school. 14. Individualized physics classes (inclusion, gifted pupils, pupil's projects, contests). 15. Standards for constructing a curriculum in physics. Laboratory exercises (LE) – 30 hours: Students prepare experimental setup, run experiments, describe and explain results that will be done by them or their pupils. Seminar and praxis in high school (S) – 30 hours: Observing cooperating teacher's lessons, writing lecture plans and giving trial lectures under supervision of cooperating teacher and university teacher.
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☑ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Attendance of at least 80% of lectures and 80% of laboratory exercises. Observing 30 classes in high school. Written lecture plans for two lessons and two trial lectures given in high school.

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

Assessment and evaluation of student work

- class attendance and homework – up to 10 points
- Written high school lecture plans – up to 14 points
- Two lectures given in a high school– up to 16 points
- Notes from the class observations and seminar (analysis and self-analysis) up to 10 points,
- Written exam – up to 10 points
- Oral exam – up to 20 points
- Laboratory exercises – up to 20 points Written exam is consisted of problems (exercises) that are appropriate high school physics level. Oral exam is consisted of 5 conceptual questions randomly selected from a pre-given list of questions. Each question is from a different teaching unit.

Final grade is given as follows:

- 89 – 100 points: excellent
- 76 – 88 points: very good
- 63 – 75 points: good
- 50 – 62 points: sufficient

Required literature

Title	Number of copies available	Availability on other medium
R. Krsnik, Suvremene ideje u metodici nastave fizike, Školska knjiga, Zagreb, 2008.		
V. Mešić, Uvod u didaktiku fizike, PMF Univerziteta u Sarajevu, Sarajevo 2015.		
Ž, Jakopović, Kurikulum i nastava fizike, Školska knjiga, Zagreb 2016.		
Approved high school physics textbooks.		

Supplementary literature	B. Arons, Teaching Introductory Physics, John Wiley & Sons Inc. 1996. E. F. Redish, Teaching Physics with the Physics Suite, John Wiley & Sons Inc. 2003. Paul G. Hewitt, Conceptual Physics, 12th Edition, Addison-Wesley, 2014.
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	Physics Education III						
ID	PMP250	Study year	2.				
Lecturer	prof. dr. sc. Mile Dželalija	Points value (ECTS)	6.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	30	30	0	
Subject status	Elective	Online percentage	20%				
Subject description							
Subject goals	• To capacitate students in lecture plan writing and teaching lessons in physics in high school using different teaching tools. • To develop the ability of evaluation of pupil's conceptual knowledge in physics. • To be acquainted with the possibilities and demands of evaluation on a large scale. • To develop knowledge of the influence of education research on the development of efficient methods in teaching. • To be familiarized with the latest achievements in educational physics and to be acquainted with the application of newer and different methods in active learning and teaching.						
Enrolment requirements	• Physics Education I • Physics Education II						
Learning outcomes	• To be able to use professional literature and other relevant information sources in order to write lecture plans. • To adapt old or to produce new teaching materials in order for it to be motivating for active learning of all pupils. • To analyze the possibilities, demands and results of large scale testing. • To apply basic experimental techniques and measured data processing. • To define measurable learning outcomes of physics classes in accordance with curriculum. • To apply knowledge in psychology, pedagogy, didactics and methods in teaching physics. • To use ICT technologies in physics classes. • To apply modern tools and methods for interactive physics teaching.						
Syllabus	Lectures (L) – 30 hours: 1. Introduction lesson (introducing students and lecturers, description of work methods, student obligations and evaluations of achievements). 2. Implications of research in teaching physics (approaches, methodologies, qualitative and quantitative research). 3. Construction of tests and psychometric models. 4. Standardized instruments for evaluation of the level of adoption of physical concepts. 5. Implication of cognitive models in learning and teaching. 6. Cognitive levels of knowledge and taxonomy. 7. Basic principles of evaluation of pupil's accomplishments in physics. 8. Program for International Student Assessment (PISA). 9. Trends in International Mathematics and Science Study (TIMSS). 10. Lifelong professional development of teachers. 11. Scientific and professional journals for physics teachers. 12. How to get and keep pupils interested in a teaching lesson. 13. Few efficient methods of teaching (flipped classroom, peer learning, models of the classroom). 14. Tools for interactive teaching in physics. 15. Student projects, working in groups, e-learning. Laboratory exercises (LE) – 30 hours: Students prepare experimental setup, run experiments, describe and explain results that will be done by them or their pupils in high schools. Seminar and praxis in high or higher school (S) – 30 hours:						

	Observing cooperating teacher's lessons, writing lecture plans and giving trial lectures under supervision of cooperating teacher and university teacher.					
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☑ Laboratory ☑ Mentoring		☑ homework assignments ☐ ☐ ☐	
Student obligations	Attendance of at least 80% of lectures and 80% of laboratory exercises. Observing 30 classes in high or higher school. Written lecture plans for two lessons and two trial lectures given in high or higher school.					
Monitoring student work	Class attendance	1	Research		Practical work	1.5
	Experimental work	1	Paper		Domaće zadaće	0.5
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam	1		
	Written exam	0.5	Project			
Assessment and evaluation of student work	• Class attendance and homework – up to 10 points • Written lecture plans for high school – up to 14 points • Two lectures given in a high school school– up to 16 points • Notes from the class observations and seminar (analysis and self-analysis) up to 10 points • Written exam – up to 10 points • Oral exam – up to 20 points • Laboratory exercises – up to 20 points Written exam is consisted of problems (exercises) that are appropriate for high school physics level. Oral exam is consisted of 5 conceptual questions randomly selected from a pre-given list of questions. Each question is from a different teaching unit. Final grade is given as follows: • 89 – 100 points: excellent • 76 – 88 points: very good • 63 – 75 points: good • 50 – 62 points: sufficient					

Required literature	Title	Number of copies available	Availability on other medium
	E. F. Redish, Teaching Physics with the Physics Suite, John Wiley & Sons Inc. 2003.		
	E. Mazur, Peer Instruction: A User's Manual, Prentice Hall, 1997		
	Papers from current periodicals: Am. J. Phys, Phys. Teach, Phys. Educ, Int. J. of Sci. Educ.		
	Approved physics textbooks for high and higher school.		

Supplementary literature	B. Arons, Teaching Introductory Physics, John Wiley & Sons Inc. 1996. Paul G. Hewitt, Conceptual Physics, 12th Edition, Addison-Wesley, 2014.

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)	

<table>
<tr><td>Subject name</td><td colspan="3">Methods of Instructions in Applied Mathematics</td></tr>
<tr><td>ID</td><td>PMM133</td><td>Study year</td><td>1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Damir Vukičević</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>Compulsory</td><td>Online percentage</td><td>5%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">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="3">Prerequisites: introductory mathematical course completed.
Required competencies: knowledge of elementary mathematics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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="3">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.
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>☑ Lectures
☐ Seminars
☑ Exercises</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia</td><td>☐
☐
☐</td></tr>
</table>

	☐ Fully online ☐ Combined online		☐ Laboratory ☐ Mentoring		☐	
Student obligations	Lecture attendance.					
Monitoring student work	Class attendance	1.5	Research		Practical work	
	Experimental work		Paper		Ispit	3.5
	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
	N. Koceić Bilan, Primijenjena statistika		
	N. Koceić Bilan, Nastavni materijal iz Osnova financijske matematike		
Supplementary literature	B. Šego, Z. Lukač Financijska matematikaA. Šegota: Financijska matematika, Udžbenici Sveučilišta u Rijeci 2012 Financijska matematika, ppt, Ekonomski fakultet Sveučilišta u Zagrebu		
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="7">Interaction Design Methodology</td></tr>
<tr><td>ID</td><td>PMIH40</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Andrina Granić</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>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">Acquisition of fundamental knowledge related to the interdisciplinary field of Interaction Design (ID) defined as the design of interactive products to support people in their everyday and working lives, including psychological and social aspects of users, interaction styles, user requirements, up-to-date design approaches, usability and evaluation, traditional and future interface paradigms.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">No formal prerequisites, but it would be preferable if students have already acquired basic knowledge from the course Human-Computer Interaction I: Fundamental Principles.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">1. Name and explain fundamental terminology and concepts from the Interaction Design (ID) field.
2. Decide on and critically evaluate selection of adequate methods for the design of user-centred interactive products (different phases of information collection, planning, prototyping and evaluation).
3. Critically evaluate positive and negative aspects of different design methods from the HCI field to be used in interactive product development.
4. Compare and decide on adequate methodology for interactive product evaluation.
5. Argue on the role of available HCI methods in system development.
6. Use case: critically evaluate reasons for the development of interactive system /product; identify context of use and collect all relevant information in relation to the goal; produce personas, scenarios of use and low fidelity prototypes; apply adequate user-centred design methods; produce high fidelity prototypes; decide on and employ adequate evaluation approach.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures:
1. Interaction Design (ID): definitions and fundamental principles (2h)
2. Short chronology on interaction design (2h)
3. Usability, user experience, quality in use (2h)
4. Designing for user experience (2h)
5. Research methods: visualization of information, interfaces and interactions (2h)
6. Invited lecture (2h)
7. Interaction Design model: user-centred design, prototyping, evaluation, implementation4h)
8. Personas and scenarios (2h)
9. Sketching, low and high fidelity prototypes (2h)
10. Participatory design (2h)
11. Methods and approaches to interaction evaluation (4h)
12. The future of Interaction Design (4h)
Exercises:
1. Introduction to course exercises - generally about structure of exercises; gained knowledge and skills; topics which will be covered; work flow; individual and group tasks; grading.
2. Introduction to interaction design - digital artefacts design; new technologies; new interfaces; 1. individual task for students (analysis of 3 interaction design examples).
3. Presentations of the 1. individual student tasks - analysis and discussion.</td></tr>
</table>

	4. Accessibility – design for all and universal accessibility; accessibility and usability; disability categories and examples of accessible interaction design; 2. individual task for students (analysis of interactive interfaces designed for disabilities categories). 5. Presentations of the 2. individual student tasks – analysis and discussion. 6. Understanding users – emotional aspects; emotional interfaces; persuasive technologies; anthropomorphism; virtual agents and characters; virtual learning assistants. 7. User experience design – 5 design levels; user needs; creation of the “personas”. 8. Introduction to group project – design, evaluation and implementation of interactive object interface; analysis of current examples. 9. Selection of the concept for interactive object – group work. 10. Making a prototype of the interactive object interface – group work. 11. Evaluation of the interactive object interface – group work. 12. Group presentations of conducted evaluation – analysis and discussion. 13. Defining necessary changes on interactive object interfaces – group work. 14. Implementation of necessary changes on interactive object interfaces – group work. 15. Group projects – final presentations of student projects
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 in the assigned project and given use case; final oral exam

Monitoring student work

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

Assessment and evaluation of student work	Quality of performance of assigned tasks (50%). Oral exam (50%).

Required literature

Title	Number of copies available	Availability on other medium
J. Preece, Y. Rogers, H. Sharp: Interaction Design: Beyond Human-Computer Interaction, John Wiley & Sons, 4th Edition, 2015.		
D. Saffer: Designing for Interaction, Second Edition: Creating Innovative Applications and Devices, New Riders, 2010.		

Supplementary literature	1. D. Norman: Emotional Design: Why We Love (or Hate) Everyday Things, Basic Books, 2005. 2. B. Shneiderman: Human Needs and the New Computing Technologies, MIT Press, 2003. Svi nastavni materijali dostupni on-line, uključujući i dodatnu znanstvenu literaturu

Quality assurance	student discussion, anonymous student evaluation questionnaire, student success rate, self-assessment
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">Research Methodology in Natural Sciences</td></tr>
<tr><td>ID</td><td>PMP104</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>4.0</td></tr>
<tr><td>Associates</td><td></td><td>Class execution (number of hours in semester)</td><td>L: 30, S: 0, E: 15, 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">To familiarize students with research methods in the field of natural sciences.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Enrolled one of the diploma study programs.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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="3">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
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">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>Monitoring student work</td><td colspan="3">Class attendance: 2 · Research: · Practical work:
Experimental work: · Paper: </td></tr>
</table>

	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)						

Subject name	Metric spaces		
ID	PMM601	Study year	1.
Lecturer	izv. prof. dr. sc. Goran Erceg	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 45, S: 0, E: 0, P: 0
Subject status	Compulsory	Online percentage	30%
Subject description			
Subject goals	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.		
Enrolment requirements	Successfully completed course: Introduction to topology		
Learning outcomes	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		
Syllabus	– 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. – 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.		
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory	☐ ☐ ☐ ☐

	☐ Combined online		☐ 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	0	Ispit	4.5	
	Essay		Seminar paper				
	Colloquiums		Oral exam				
	Written exam		Project				
Assessment and evaluation of student work	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						
Required literature	Title	Number of copies available	Availability on other medium				
	J. Munkres, Topology, Pearson Education International, New York, 2000		da				
	S. Shirali, H. Vasudeva, Metric spaces, Springer-Verlag, London 2006.		da				
	S. Mardešić, Matematička analiza u n-dimenzionalnom realnom prostoru I, Školska knjiga, Zagreb, 1974.						
Supplementary literature	J. Dugundji, Topology, Allyn and Bacon Inc., Boston, 1966. 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)							

<table>
<tr><td>Subject name</td><td colspan="6">Measure and integral</td></tr>
<tr><td>ID</td><td>PMM913</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Vesna Gotovac Đogaš
dr. sc. Ivan Jelić</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">15%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Students will:
– acquire a basic knowledge on measure theory,
–learn construction of a measure via an exterior measure,
–be introduced with the Lebesgue measure on Rn and its properties,
–be introduced with a notion of measurable function and its properties,
– gain insight in the theory of Lebesgue integration,
–learn to differ Riemann integral form the Lebesgue integral,
–familiarise with Lp spaces, their interrelationships and basic properties,
–gain insight into various decompositions of signed measures such as Hahn's, Jordan's and Lebesgue's decomposition,
–learn the construction of a product measure,
–learn to apply Fubini's theorem,
– to get acquainted with Riesz's theorem of representation of positive linear functionals in the space of continuous functions.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Course enrolment : Successfully completed courses Fundamentals of mathematical analysis and Linear algebra II.
Entry competences : Students should be comfortable with using the following concepts: set operations, topology, topology and metric structure of Rn.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Upon successful completion of this course students will be able to:
–explain notions of measure and measure space,
–construct a measure via an exterior measure applying Carathéodory's extension theorem,
–define the Lebesgue measure on Rn and to show its properties,
–compute the integral of a measurable function,
–prove various properties of the Lebesgue integral,
– differ Riemann integral form the Lebesgue integral,
– construct a product measure and apply Fubini’s theorem,
– define Lp spaces and prove their basic properties,
– decompose a signed measure with respect to Hahn's, Jordan's and Lebesgue's decomposition,
– describe the basic types of convergence of measurable functions and the relationships between them.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Introduction. Semirings and rings of sets. Sigma – ring of sets.
2. Finitely and countably additive functions. Measures on rings.
3. Caratheodory construction.
4. Lebesgue measure. Regularity. Measures on reals.
5. Measurable functions. Integral of a simple function.
6. Integral of a nonnegative function. Monotone convergence theorem.</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">7. Integrable functions. Dominated convergence theorem.
8. Lebesgue Lp – spaces.
9. Hahn and Jordan decomposition of a measure. Absolute continuity. Singularity.
10. Radon – Nikodym theorem. Lebesgue decomposition.
11. Convergence types. Egorov theorem.
12. Product measures. Fubini – Tonelli theorem.
13. Riesz representation theorem of positive linear functionals.</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. 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>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>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">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.</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">R.G. Bartle, The Elements of Integration and Lebesgue Measure, John Wiley & Sons, Inc., 1995</td><td></td><td></td></tr>
<tr><td colspan="4">D. L. Cohn, Measure Theory, Springer, 2013.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">G. B. Folland, Real Analysis: Modern Techniques and Their Applications, John Wiley & Sons, Inc., 2013.

D. Jukić, Uvod u teoriju mjere i integracije, Osijek, 2008.

N. Antonić, M. Vrdoljak, Mjera i integral, PMF-Matematički odjel, Zagreb, 2001</td></tr>
<tr><td>Quality assurance</td><td colspan="6">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.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

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: 30, S: 20, E: 10, P: 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: Physical and Numerical Aspects Academic Press, 2007.		da
	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)	

Subject name	Modelling and Simulations of Biomacromolecule						
ID	PMP249	Study year	2.				
Lecturer	izv. prof. dr. sc. Željka Sanader Maršić	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	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 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
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring ☑ homework assignment ☐ ☐ ☐
Student obligations	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.

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			

Assessment and evaluation of student work	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.

Required literature:

Title	Number of copies available	Availability on other medium
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)	

<table>
<tr><td>Subject name</td><td colspan="7">Modern Physics</td></tr>
<tr><td>ID</td><td>PMP008</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>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">Understanding of the basic concepts of modern physics and ability to explain them to others.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Passed exams in General Physics I, General Physics II, Mathematics I and Mathematics II</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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.</td></tr>
<tr><td>Syllabus</td><td colspan="6">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).</td></tr>
</table>

	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)			

Subject name	Modern spectroscopy		
ID	PMP207	Study year	2.
Lecturer	izv. prof. dr. sc. Martina Požar	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	30%

Subject description	
Subject goals	Understanding of theoretical principles of spectroscopy. The ability to connect the theoretical principles of spectroscopy to the experiment. The application of group theory to molecules and its uses in spectroscopy.
Enrolment requirements	Basic knowledge of general and quantum physics.
Learning outcomes	After the exam the student should: 1. Know how to explain the basic principles of spectroscopy. 2. Be able to explain the physical principles that form the basis of spectroscopic methods. 3. Know how to interpret the spectra of selected experimental methods. 4. Be able to state and elaborate on the application of spectroscopic methods in science. 5. Know how to explain the work principle behind spectroscopic methods. 6. Understand the application of group theory on molecules and its uses in spectroscopy.
Syllabus	Lectures: (5h) The basic principles of spectroscopy (3h) Rotational spectroscopy (5h) Vibrational spectroscopy (5h) Electron spectroscopy (2h) Spin-resonant spectroscopies (10h) Group theory application in spectroscopy Exercises: (15h) During the semester, the students participate in exercises, whch may be either auditory or experimental (depending on the circumstances). Seminars: (15h) Approaching the end of the semester, the students work on their seminary papers and present them in a seminary presentation.
Teaching types	[x] Lectures [x] Seminars [ ] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [ ] Individual assignments [ ] Multimedia [x] Laboratory [ ] Mentoring
Student obligations	The attendance and activity during the lectures and exercises. It's necessary to have at least 70% attendance. Presented seminary paper.

Monitoring student work

Class attendance	1	Research		Practical work	
Experimental work	2	Paper			
Essay		Seminar paper	0.5		
Colloquiums		Oral exam	2.5		

	Written exam		Project			

Assessment and evaluation of student work	The final grade consists of three parts: 1. theoretical knowledge (50 %), 2. presentation of the seminary paper (30 %), 3. work during the exercises/experiment (20 %).

Required literature	Title	Number of copies available	Availability on other medium
	R Chang, Basic Principles of Spectroscopy, McGraw-Hill Book Company, 1971.		yes
	C.N. Banwell, E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th edition, Mc Graw Hill India, 2016.		yes
	A. Vincent, „Molecular Symmetry and Group Theory", Wiley & sons, 2013.		yes

Supplementary literature	J. M. Hollas, Basic Atomic and Molecular Spectroscopy, The Royal Society of Chemistry, 2002. J. M. Hollas, Modern spectroscopy, 4th edition, John Wiley & Sons Ltd, 2004. G. Gauglitz, D. S. Moore, Handbook of Spectroscopy, 2nd edition, John Wiley & Sons Ltd, 2014. J. Z. Zhang, Optical Properties and Spectroscopy of Nanomaterials, World Scientific, 2009. A. Myers Kelley, Condensed-Phase Molecular spectroscopy and Photophysics, John Wiley & Sons Ltd, 2013.
Quality assurance	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)	

Subject name	Molecular Genetics		
ID	PMB545	Study year	2.
Lecturer	doc. dr. sc. Ivica Šamanić	Points value (ECTS)	3.5
Associates		Class execution (number of hours in semester)	L: 30, S: 15, E: 0, P: 0
Subject status	Compulsory	Online percentage	10%
Subject description			
Subject goals	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.		
Enrolment requirements	Fundamental knowledge of molecular biology and genetics are required.		
Learning outcomes	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		
Syllabus	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) 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)			

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			

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

Required literature	Title	Number of copies available	Availability on other medium
	[1] N. Zettili, "Quantum mechanics: concepts and applications".	4	
	[2] Various websites with solved examples in quantum mechanics.	0	
	[3] 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	Advanced Statistical Physics		
ID	PMP115	Study year	3.
Lecturer	prof. dr. sc. Larisa Zoranić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 45 S: 15 E: 15 P: 0
Subject status	Compulsory	Online percentage	5%
Subject description			
Subject goals	Understanding the behavior of systems of many particles through thermodynamics and statistical physics.		
Enrolment requirements	Passed courses in General Physics, Modern Physics, Mathematics and attended introductory courses in statistical physics and classical mechanics.		
Learning outcomes	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.		
Syllabus	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. 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	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory	☐ ☐ ☐ ☐

	☐ Combined online		☐ 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)						

Subject name	Nasilje među djecom						
ID	PMS176	Study year	1.				
Lecturer	doc. dr. sc. Anna Alajbeg	Points value (ECTS)	2.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			15	15	0	0	
Subject status	Elective	Online percentage	0%				
Subject description							
Subject goals	Upoznati studente s fenomenom klasičnog i elektroničkog vršnjačkog nasilja. Razumijevanje osnovnih utjecaja različitih vrsta nasilja na psihosocijalni razvoj djece i posljedice u kasnijoj dobi. Razviti sposobnost odabira adekvatnih metoda u prevenciji i intervenciji u činu vršnjačkog nasilja						
Enrolment requirements							
Learning outcomes	• Interpretirati i klasificirati znanstveno utvrđene oblike nasilja među djecom • Osposobljenost za identifikaciju različitih oblika klasičnog i elektroničkog vršnjačkog nasilja • Prepoznati i objasniti rizične čimbenike na individualnoj i društvenoj razini za pojavu fenomena nasilja među djecom • Kritički procjenjivati i određivati primjerene metode postupanja na razini primarne prevencije; • Planirati profesionalno utemeljene postupke u skladu sa zakonskom regulativom. • Sposobnost ranog uočavanja problema vršnjačkog nasilja • Razvoj kompetencija za pomaganje djeci koja su sudjelovala u nasilju • Pripremljenost za suradnju s drugim stručnjacima i obiteljima te službeno postupanje (prijava) u slučajevima nasilja i zlostavljanja						
Syllabus	Nastavni sat predavanja 1. Uvodni sat - upoznavanje s kolegijem 2. Nasilje među djecom – povijesni pregled 3. Sukobi, nasilje i zlostavljanje - terminološko određenje 4. Oblici i obilježja klasičnog vršnjačkog nasilja 5. Oblici i obilježja elektroničkog vršnjačkog nasilja 6. Individualni čimbenici rizika i zaštite u vršnjačkom nasilju 7. Obiteljski čimbenici rizika i zaštite u vršnjačkom nasilju 8. Školski čimbenici rizika i zaštite u vršnjačkom nasilju 9. Uloge djece u klasičnom nasilju među djecom 10. Uloge djece u elektroničkom nasilju među djecom 11. Posljedice klasičnog i elektroničkog vršnjačkog nasilja 12.-13. Zaštita, postupanje i prevencija vršnjačkog nasilja 14. Priprema za kolokvij 15. Kolokvij Nastavni sat seminara 1. Podjela seminarskih radnji. Upute za pisanje seminarskih						

	radnji 2. Zakonska regulativa i pravna zaštita djece u Republici Hrvatskoj 3. Teorijski modeli nasilnih roditeljskih ponašanja prema djeci 4. Nasilje u mladenačkim vezama 5. Rizični i zaštitni čimbenici za zlostavljanje djece 6. Tjelesno kažnjavanje djece 7. Emocionalno zlostavljanje 8. Seksualno zlostavljanje, posljedice i tretman 9. Razvod roditelja i manipulacija djecom pri razvodu roditelja 10. Mediji i nasilje među djecom 11. Karakteristike počinitelja s obzirom na vrstu nasilja 12. UNICEF-ov preventivni program „Stop nasilju među djecom" 13. UNICEF-ov preventivni program „Stop nasilju među djecom" – prevencija elektroničkog zlostavljanja 14. Olweusov preventivni program 15. KiVa preventivni program
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring ☐ ☐ ☐ ☐
Student obligations	Redovito pohađanje i aktivno sudjelovanje u nastavi, seminari (pozitivno ocijenjen napisani seminarski rad i prezentacija), polaganje kolokvija ili ispita.

Monitoring student work

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

Assessment and evaluation of student work	Završna ocjena iz kolegija Nasilje među djecom određuje se temeljem uspjeha postignutom na kolokviju tijekom predavanja i seminara. Studenti moraju napisati jedan seminarski rad u kojem će obraditi zadanu temu s popisa tema seminarskih radova. Seminar se ocjenjuje ocjenom od 1 do 5. Ocjena iz teorijskog dijela određuje se temeljem uspjeha postignutog na usmenom teorijskom kolokvijiu koji se održava u petnaestom tjednu nastave. Usmeni odgovori studenata ocjenjuje se ocjenom od 1 do 5. Konačna ocjena iz kolegija Nasilje među djecom izračunava se na sljedeći način:(ocjena teorija) + (ocjena seminar) + (redovitost i zalaganje na nastavi).

Required literature	Title	Number of	Availability on other medium

		copies available	
	Bilić, V. (2018). Nove perspektive, izazovi i pristupi nasilju među vršnjacima. Obrazovni izazovi i Učiteljski fakultet u Zagrebu. Zagreb		
	Bilić, V., Buljan Flander, G., Hrpka, H. (2012). Nasilje nad djecom i među djecom. Jastrebarsko: Naklada Slap		
	Olweus, D. (1993). Nasilje među djecom u školi. Zagreb: Školska knjiga		
Supplementary literature	Bilić, V. i Zloković, J. (2004). Fenomen maltretiranja djece, Naklada Ljevak, Zagreb. Pregrad, J. i sur. (2007). Priručnik Stop nasilju među djecom, UNICEF 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)			

Subject name	Normed spaces		
ID	PMM605	Study year	1.
Lecturer	prof. dr. sc. Saša Krešić Jurić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 45, S: 0, E: 0, P: 0
Subject status	Compulsory	Online percentage	30%

Subject description

Subject goals	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.
Enrolment requirements	Courses taken: Metric spaces, Vector spaces
Learning outcomes	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
Syllabus	– 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.
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	

<table>
<tr><td></td><td>Experimental work</td><td></td><td>Paper</td><td></td><td>Ispit</td><td>4.5</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></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">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.</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">E. Kreyszig, Introductory functional analysis, John Wiley and sons, New York, 1978.</td><td></td><td>da</td></tr>
<tr><td colspan="4">S. Kurepa, Funkcionalna analiza, Liber, Zagreb, 1992</td><td></td><td></td></tr>
<tr><td colspan="4">J.J. Koliha, Metrics, Norms, Integrals, World Scientific, London, 2008.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">G. Bachman, L. Narici, Functional analysis, Dover Publications, New York, 2000.
W. Rudin, Functional analysis, McGraw-Hill, New York, 1973.</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Exam statistics and students' quality evaluation through anonymous poles.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

Subject name	Nuclear Physics						
ID	PMP203	Study year	1.				
Lecturer	doc. dr. sc. Ivana Weber	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	0%				
Subject description							
Subject goals	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.						
Enrolment requirements	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.						
Learning outcomes	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.						
Syllabus	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.						
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐				

<table>
<tr><td>Student obligations</td><td colspan="6">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></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>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">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="4">Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td colspan="4">J.Rich, M. Spiro, Fundamentals in Nuclear Physics, Springer 2005</td><td>3</td><td></td></tr>
<tr><td colspan="4">Prezentacije predavanja i vježbi, I. Weber</td><td></td><td>Online – dostupno svima</td></tr>
<tr><td>Supplementary literature</td><td colspan="6">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="6">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="6"></td></tr>
</table>

<table>
<tr><td>Subject name</td><td colspan="5">Numerical analysis</td></tr>
<tr><td>ID</td><td>PMM118</td><td colspan="2">Study year</td><td colspan="2">1.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Jurica Perić</td><td colspan="2">Points value (ECTS)</td><td colspan="2">5.0</td></tr>
<tr><td rowspan="2">Associates</td><td rowspan="2"></td><td colspan="2" 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 colspan="2">Online percentage</td><td colspan="2">40%</td></tr>
<tr><td colspan="6">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="5">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.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="5">Successfully completed course „Introduction to numerical mathematics“.</td></tr>
<tr><td>Learning outcomes</td><td colspan="5">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</td></tr>
<tr><td>Syllabus</td><td colspan="5">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</td></tr>
<tr><td>Teaching types</td><td>☑ 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="5">Attendance at 70% of lectures and 70% of exercises.</td></tr>
<tr><td rowspan="5">Monitoring student work</td><td>Class attendance | 1</td><td>Research</td><td></td><td>Practical work</td><td></td></tr>
<tr><td>Experimental work</td><td>Paper</td><td></td><td></td><td></td></tr>
<tr><td>Essay</td><td>Seminar paper</td><td></td><td></td><td></td></tr>
<tr><td>Colloquiums | 1.5</td><td>Oral exam</td><td>1.5</td><td></td><td></td></tr>
<tr><td>Written exam | 1</td><td>Project</td><td></td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="5">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>
</table>

<table>
<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>V. Hari at all, Numerička analiza, PMF-MO, Zagreb, 2003.</td><td></td><td></td></tr>
<tr><td>J. Stoer, R. Bulirsch, Introduction to Numerical Analysis, Springer, New York, 1993.</td><td></td><td></td></tr>
<tr><td>Nicholas J. Higham, Accuracy and Stability of Numerical Algorithms, SIAM, 2002.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">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</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	Numerical Modelling of Electronic Structure		
ID	PMP402	Study year	2.
Lecturer	izv. prof. dr. sc. Željka Sanader Maršić	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 15, P: 0
Subject status	Elective	Online percentage	20%

Subject description

Subject goals	Upoznavanje s teorijskim i numeričkim metodama za određivanje elekronske strukture i transporta na nanoskali.
Enrolment requirements	Poznavanje: kvantne mehanike, osnova fizike čvrstog stanja, osnova numeričkog programiranja.
Learning outcomes	Savladavanja gradiva trebalo bi omogućiti: 1. razumijevanje problema interagirajućih elektrona 2. shvaćanje teorije funkcionala gustoće kao teorije koreliranih sistema 3. razumijevanje valjanosti aproksimacija na funkcionale u ovisnosti o sistemu čestica 4. odabir pseudopotencijala i korištenje njihove transferabilnosti 5. korištenje numeričkih paketa pri izračunu elektronske strukture sistema 6. određivanje svojstava atoma, molekula i čvrstih tvari
Syllabus	1. Uvod u više-čestični problem interagirajućih elektrona (Harteee-Fockova aproksimacija, energija zamjene i korelacije), 5 sati 2. Matrica gustoće, 2 sata 3. Thomas-Fermi-Dirac aproksimacija, pr. funkcionala, 2 sata 4. Teorija funkcionala gustoće (DFT): Hohenberg-Kohn teoremi, 4 sati 5. Kohn-Sham ansatz i jednadžbe, 6 sati 6. Funkcionali za zamjenu i korelacije u: aproksimacija lokalne gustoće (LDA), aproksimaciji generaliziranog gradijenta (GGA), orbitalno ovisnih funcionala, hibridnih funkcionala, 5 sati 7. Pseudopotencijali, 5 sati 8. Metode određivanja elektronske strukture atoma, molekula i kondenzirane tvari, 6 sati 9. Upoznavanje sa odabranim numeričkim komputerskom paketima. 10 sati
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☑ Grupni rad ☐ ☐ ☐
Student obligations	Pohađanje nastave i aktivno sudjelovanje na vježbama. Predana izvješća o izvršenim vježbama.

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			

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">Predana izvješća o izvršenim vježbama. Usmeni ispit.</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>1. Richard M. Martin: “Electronic Structure”, Cambridge University Press, 2004. 2. Prezentacije s predavanja, web</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">1. Robert G. Paar and WeitaoYang: Density-functional theory of atoms and molecules, Oxford University Press 1989.
2. J. Kohanoff: “Electronic Structure Calculations for Solids and Molecules”, Cambridge University Press, 2006</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">Signal Processing in Natural Sciences</td></tr>
<tr><td>ID</td><td>PMP125</td><td>Study year</td><td>2.</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 S E P
30 0 30 0</td></tr>
<tr><td>Subject status</td><td>Elective</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">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="3">Enrolled one of the diploma study programs.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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="3">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
☐ Combined online</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☑ Laboratory
☐ Mentoring</td><td>☐
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">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>Monitoring student work</td><td colspan="3">
<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>
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</td></tr>
</table>

	Essay		Seminar paper	2		
	Colloquiums	1	Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	The grade is determined based on: - Colloquium (25% grade) - Seminar paper (50% grade) - Oral presentation (25% grade)					
Required literature	Title				Number of copies available	Availability on other medium
	Hrvoje Babić (2001.), Signali i sustavi					
	William Hartmann: Signals, Sound, and Sensation					
	B. P. Lathi (2004.), Linear Systems and Signals					
Supplementary literature	Oppenheim, Alan, and Alan Willsky. Signals and Systems					
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="3">Full Stack Development</td></tr>
<tr><td>ID</td><td>PMIC61</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Goran Zaharija</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>20%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">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="3">Web Application Programing (Programiranje mrežnih aplikacija)
Databases (Baze podataka)</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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="3">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>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td>☑
Workshops
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3"></td></tr>
</table>

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

Assessment and evaluation of student work	Attendance (10%) Practical work (30%) Written / oral exam (60%)		
Required literature	Title	Number of copies available	Availability on other medium
	Ben Frain, Responsive Web Design with HTML5 and CSS3, Packt Publishing; second edition (2017)		
	Chris Aquino, Todd Gandee; Front-End Web Development: The Big Nerd Ranch Guide; Big Nerd Ranch Guides; first edition (2016)		
	Vasan Subramanian; Pro MERN Stack: Full Stack Web App Development with Mongo, Express, React, and Node; Apress; first edition (2017)		
Supplementary literature	Teaching materials available on the Internet, including solutions to selected tasks and additional scientific literature		
Quality assurance	Conversation with students, anonymous student survey, student success on the course, self-analysis.		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">Operators on Normed Spaces</td></tr>
<tr><td>ID</td><td>PMM607</td><td>Study year</td><td colspan="4">2.</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 to the fundamentals of the theory of bounded operators on normed spaces, and in particular on unitary spaces. The emphasis is on the spectral theory of bounded operators, hence the students are introduced first to the theory of Banach algebras and then to the main results about the spectrum of bounded operators. Finally, the students are also introduced to some results about compact operators.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Taken course Normed spaces.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">The student is able to:

Explain the importance of bounded operators on normed (Banach) spaces and in particular on unitary (Hilbert) spaces.

Define all special subclasses of bounded operators (e.g. positive operators, compact operators, finite rank operators, etc.) and illustrate each case with examples and/or counterexamples.

Define the notion of normed (Banach) algebra, the resolvent and spectrum of an element of a Banach algebra or the resolvent and spectrum of a bounded operator, and illustrate these notions with examples and/or counterexamples.

State the basic theorems about the spectrum of an element of a Banach algebra or about the spectrum of a bounded operator from some of the special subclasses.
Prove the stated theorems.

Apply the theorems to concrete examples.</td></tr>
<tr><td>Syllabus</td><td colspan="6">Bounded operators on unitary spaces: the adjoint of a bounded operator, positive operators, the polar decomposition of an operator (10 hours).

Normed algebras: Banach algebras, the spectrum, the spectral radius and the resolvent of an element of a Banach algebra (8 hours).

Bounded operators: the spectrum of a bounded operator, the point spectrum, the continuous spectrum and the residual spectrum, the resolvent set and the resolvent of an operator (10 hours).

Compact operators: compact operators on normed spaces, compact operators on Hilbert spaces, finite rank operators (10 hours).

Compactness of some integral operators (7 hours).</td></tr>
<tr><td>Teaching types</td><td>☑ Lectures
☑ Seminars
☐ Exercises</td><td>☐ Fieldwork
☐ Individual assignments
☐ Multimedia</td><td colspan="4">☐
☐
☐</td></tr>
</table>

	☐ Fully online ☐ Combined online	☐ Laboratory ☐ Mentoring	☐
Student obligations	Class and seminar attendance, solving and discussing homework problems at seminars, self-learning of prescribed material by using the obligatory and optional literature.		

Monitoring student work	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper		Ispit	4
	Essay		Seminar paper	1.5		
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	Final written and oral exam. Positive grade of 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
	E. Kreyszig, Introductory functional analysis, John		da
	Wiley and sons, New York, 1978.		
	S. Kurepa, Funkcionalna analiza, Liber, Zagreb, 1992		
Supplementary literature	G. Bachman, L. Narici, Functional analysis, Dover Publications, New York, 2000. W. Rudin, Functional analysis, McGraw-Hill, New York, 1973.		
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)			

Subject name	Optimization		
ID	PMM922	Study year	1.
Lecturer	prof. dr. sc. Milica Klaričić Bakula	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 15, E: 0, P: 0
Subject status	Compulsory	Online percentage	30%

Subject description	
Subject goals	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.
Enrolment requirements	Entry competences: Linear algebra. Numerical linear algebra (basics).
Learning outcomes	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.
Syllabus	– 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)
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Attending classes, doing homework assignments. Writing and presenting seminars.

Monitoring student work						
	Class attendance	2	Research		Practical work	0.5
	Experimental work		Paper			
	Essay		Seminar paper	0.5		

	Colloquiums	2	Oral exam			
	Written exam		Project			

Assessment and evaluation of student work	Seminars will be evaluated throughout the semester. Final oral exam.

Continuous assessment		
Evaluation elements	Performance (min)	Weight in grade (%)
partial written exams	50	80
solving problems with Matlab	100	20

Final assessment		
Evaluation elements	Performance (min)	Weight in grade (%)
final exam	50	80

Required literature	Title	Number of copies available	Availability on other medium
	S. Boyd and L. Vandenberghe, Convex Optimization, Cambridge University Press, 2004		e-learning

Supplementary literature	1. J. Nocedal and S.J.Wright, Numerical Optimization, Springer, 2006. 2. A. Ben-Tal and A. Nemirovski. Lectures on Modern Convex Optimization. 2013.
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">Fundamentals of Astronomy and Astrophysics</td></tr>
<tr><td>ID</td><td>PMP130</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">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>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">Introduce students to the basic concepts of astronomy and astrophysics.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Mechanics (attended)</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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="6">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
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>☑ 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	1.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums		Oral exam	1		
	Written exam		Project			

Assessment and evaluation of student work	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
	V. Vujnović, Astronomija I, Školska knjiga Zagreb, 1993.	3	no
	V. Vujnović, Astronomija II, Školska knjiga Zagreb, 1994.	2	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)	

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	Osnove teorije strategijskih igara		
ID	PMIG20	Study year	1.
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	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">Pedagogija adolescencije</td></tr>
<tr><td>ID</td><td>PMS175</td><td>Study year</td><td colspan="4">1.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Anna Alajbeg</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">Upoznati razvojne osobine i (ne)tipična ponašanja u adolescenciji. Shvatiti i prepoznati razvojno primjerene reakcije i ponašanja adolescenata te mogućnosti i načine pedagoškog odnosno odgojno-socijalnog utjecaja na tijek razvoja adolescenta. Postići osnovne kompetencije pedagoškog rada s adolescentima i roditeljima adolescenata.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Nema ih.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">· Opisati pedagogiju adolescencije kao znanstvenu disciplinu
· Definirati i klasificirati temeljne pojmove razdoblja adolescencije
· Objasniti pojmovno određenje adolescencije kroz razvojna razdoblja te raščlaniti socijalno-ekološke činitelje i odgojne utjecaje
· Objasniti razvojne karakteristike i preispitati oblike i uzroke ponašanja karakterističnih za razdoblje adolescencije
· Razlikovati i identificirati razvojno-pedagoške teškoće u adolescenciji
· Navesti i procijeniti mogućnosti i načine odgojnog i socijalnog djelovanja na tijek razvoja adolescenta te preporučiti pedagoške intervencije
· Steći znanje o različitim oblicima neprilagođenog ponašanja adolescenata
· Kritički promišljati i raspravljati o socijalnim i odgojnim činiteljima razvoja u adolescenciji</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Pedagogija adolescencije: predmet, sadržaj, istraživanje i polje praktičnog djelovanja
2. Pojam, srodni pojmovi (pubertet, mladost) i razvojne karakteristike: tjelesne, kognitivne, emocionalne, socijalne
3. Pedagoška povijest djetinjstva i adolescencije
4. Adolescenti u socijalnom kontekstu: pristupi proučavanju adolescencije, generacijske skupine, produženo trajanje adolescencije
5. Adolescenti u teorijskom kontekstu: od bioloških do teorija kulture
6. Kognitivni razvoj: obrada informacija, donošenje odluka i pitanja procjene
7. Formiranje identiteta
8. Razvoj moralnih vrijednosti
9. Socijalni razvoj: promjena u karakteru prijateljskih i romantičnih odnosa
10. Adolescenti i njihove obitelji; odnos roditelja i adolescenata
11. Najčešći poremećaji u ponašanju u adolescenciji
12. Ponašanja i stavovi vezani uz zdravlje
13. Adolescentsko društvo, kultura i subkultura
14. Mogućnosti i oblici pedagoške prevencije i intervencije
15. Kolokvij</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	Redovito pohađanje i aktivno sudjelovanje u nastavi, seminari (pozitivno ocijenjen napisani seminarski rad i prezentacija), polaganje kolokvija ili ispita.					
Monitoring student work	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums	0.5	Oral exam	0.5		
	Written exam		Project			
Assessment and evaluation of student work	Završna ocjena iz kolegija Pedagogija adolescencije određuje se temeljem uspjeha postignutom na kolokviju tijekom predavanja i seminara. Studenti moraju napisati jedan seminarski rad u kojem će obraditi zadanu temu s popisa tema seminarskih radova. Seminar se ocjenjuje ocjenom od 1 do 5. Ocjena iz teorijskog dijela određuje se temeljem uspjeha postignutog na usmenom teorijskom kolokvijiu koji se održava u petnaestom tjednu nastave. Usmeni odgovori studenata ocjenjuje se ocjenom od 1 do 5. Konačna ocjena iz kolegija Pedagogija adolescencije izračunava se na sljedeći način:(ocjena teorija) + (ocjena seminar) + (redovitost i zalaganje na nastavi).					

Required literature	Title	Number of copies available	Availability on other medium
	Bastašić, Z. (1995, 2002), Pubertet i adolescencija. Školska knjiga, Zagreb		
	Glasser, W. (2002), Nesretni tinejdžeri. Alineja, Zagreb		
	Gudjons, H. (1994), Pedagogija – temeljna znanja. Educa, Zagreb, (peto pogl., str. 93-122)		
	Lacković-Grgin, K. (2006), Psihologija adolescencije. Slap, Jastrebarsko		

Supplementary literature	Maleš, D. (1995), Između djetinjstva i zrelosti. Temposhop, Đakovo Rice, F. P,, Dolgin, K. G. (ed.) (2008), The adolescent: development, relationships, and culture, 12th edition. Boston: Pearson/Allyn and Bacon. (odabrana poglavlja
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	Povijest i filozofija suvremene fizike		
ID	PMF3	Study year	1.
Lecturer	prof. dr. sc. Mile Dželalija	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 15, S: 0, E: 0, P: 0
Subject status	Elective	Online percentage	0%

Subject description	
Subject goals	Razumijevanje tekućih istraživanja u filozofiji opće relativnosti, visokoenergijske fizike, i kvantne teorije polja. Razumijevanje temeljnih pojmova i filozofskih postavki fizike.
Enrolment requirements	
Learning outcomes	➢ Opisati i dati kritički osvrt na pojmove vremena i prostora ➢ Opisati i dati kritički osvrst na pojmove polja, energije i mase ➢ Opsati temeljne karakteristike modela i fundamentalnih teorija te odnosa između teorija ➢ Opsiati ključne filozofske elemente istraživanja u fizici visokih energija ➢ Analizirati i objasniti klase pretpostavki i aproksimacija na odabranom problemu u fizici
Syllabus	1. Pojmovi vremena i prostora (3 h) 2. Pojmovi polja, energije, i mase (3 h) 3. Odnos između teorija te karakteristike modela i teorije (3 h) 4. Filozofija istraživanja i visokoenergijsoj fizici (3 h) 5. Pretpostavke i aproksimacije u fizici (3 h)
Teaching types	☑ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Aktivno sudjelovanje na predavanjima Istraživanje i prezentacija projektnog rada

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

Assessment and evaluation of student work	Istraživanje (50 %), prezentacija projekta (30 %), odgoovri na pitanja o projektu (20 %)

Required literature	Title	Number of copies available	Availability on other medium
	Marc Lange, An Introduction to the Philosophy of Physics, Locality, Fields, Energy, and Mass, 2002, Blackwell Publishing		da
	Nick Huggertt, Space from Zeno to Einstein: classic reading with a contemporary comentary, 1999, MIT		da
	Lawrence Sklar, Space, Time, and Spacetime, Revised Edition, 1997, University of California Press		da
Supplementary literature	Mile Dželalija, prezentacija.		
Quality assurance	Evaluacija studenata i samo-evaluacija; uspjeh studenata na provjeri u odnosu na početak		
Other (in the opinion of the proponent)			

<table>
<tr><td>Subject name</td><td colspan="6">History of Classical Physics</td></tr>
<tr><td>ID</td><td>PMP009</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Željka Sanader Maršić</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">To understand the development of physical concepts.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">None.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">To be able to explain the role physical concepts in:
1. Mechanics
2. Electrodynamics
3. Thermodynamics
4. Statistical mechanics</td></tr>
<tr><td>Syllabus</td><td colspan="6">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</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">☑ Sokratovski dijalog
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="6">Attending all forms of teaching.</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>2</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">Activity during classes seminar and final exam</td></tr>
<tr><td>Required literature</td><td colspan="4">Title</td><td>Number of</td><td>Availability on other medium</td></tr>
</table>

		copies available	
	James T. Cushing: Philosophical Concepts in Physics: The Historical Relation between Philosophy and Scientific Theories, Cambridge University Press, 1998.		
Supplementary literature	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		
Quality assurance	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.		
Other (in the opinion of the proponent)			

Subject name	History of Modern Physics		
ID	PMP103	Study year	2.
Lecturer	prof. dr. sc. Mile Dželalija	Points value (ECTS)	3.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 0, P: 0
Subject status	Elective	Online percentage	30%

Subject description

Subject goals	Critical understanding of historical development of basic concepts and principles in relativistic physics, quantum physics, elementary particle physics and cosmology.
Enrolment requirements	Basic knowledge of relativistic physics, quantum physics, elementary particle physics, and cosmology.
Learning outcomes	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.
Syllabus	(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
Teaching types	☑ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☑ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☑ Domaće zadaće ☐ ☐ ☐
Student obligations	Homework assignments during semester. Written exam.

Monitoring student work

Class attendance		Research		Practical work	
Experimental work		Paper		Domaće zadaće	1
Essay		Seminar paper	1	Završni ispit	1
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">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>

Subject name	Laboratory in Biophysics		
ID	PMP142	Study year	1.
Lecturer	doc. dr. sc. Lucija Krce	Points value (ECTS)	4.0
Associates		Class execution (number of hours in semester)	L: 10, S: 0, E: 40, P: 0
Subject status	Compulsory	Online percentage	0%
Subject description			
Subject goals	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.		
Enrolment requirements	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		
Learning outcomes	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		
Syllabus	(2h) Hemolytic activity of AMP (1h) SEM measurements of the AFM sample (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.
Teaching types	☑ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	

Monitoring student work

Class attendance	0.4	Research	0.5	Practical work	
Experimental work	1.1	Paper	2		
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
Internal materials	0	yes
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)	

Subject name	Laboratory in Electricity and Magnetism		
ID	PMP012	Study year	2.
Lecturer	prof. dr. sc. Ante Bilušić	Points value (ECTS)	3.0
Associates		Class execution (number of hours in semester)	L: 0, S: 0, E: 40, P: 0
Subject status	Compulsory	Online percentage	20%

Subject description	
Subject goals	Understanding the laws of electromagnetism through independent performance of selected experiments. Understanding and application of the detailed statistical analysis of experimental results
Enrolment requirements	Acquired learning outcomes in electricity and magnetism
Learning outcomes	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.
Syllabus	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

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, 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="3">Laboratory in Mechanics</td></tr>
<tr><td>ID</td><td>PMP011</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: 0, S: 0, E: 40, 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 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="3">Acquired learning outcomes in mechanics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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="3">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
☐ 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">Writing reports on the conducted experiments. Attendance.</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></td><td>Paper</td><td>1.5</td><td></td><td></td></tr>
</table>
</td></tr>
</table>

	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 Chemistry Education I		
ID	PMC213	Study year	2.
Lecturer	dr. sc. Roko Vladušić, v. pred.	Points value (ECTS)	2.0
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	The goal of the course is to prepare students for design and implementation of elementary school chemistry experiments in chemistry instruction. Special attention is paid to the development of the awareness how important role experiments do play in chemistry instruction.
Enrolment requirements	Chemistry Education I obligations completed (except exam); starting competencies are related to the knowledge of chemistry and ability to work with chemicals in secure and economic way.
Learning outcomes	According to the elementary school curriculum, students will be able to: – design and develop worksheets for implementation and evaluation of experimental work, – prepare and implement demonstrational and laboratory types of experiments, – create experimental situations in which pupils should make conclusions based on observations and theoretical knowledge, – perform all laboratory procedures related to experiments listed in Chemistry curriculum for elementary school, – demonstrate practical work skills and – analyse the flow and results of an experiment with focus on the cause-effect relationships
Syllabus	1. Substances and their properties (5 hours) 2. Types of substances (5 hours) 3. Air (5 hours) 4. Water and hydrogen (5 hours) 5. Composition of substances (5 hours) 6. Chemical changes (5 hours) 7. Elements and compounds (5 hours) 8. Metals, non-metal and salts (6 hours) 9. Carbon and its inorganic compounds (4 hours).
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		Research		Practical work	
Experimental work	1.5	Paper		Individual laboratory tasks	0.5
Essay		Seminar paper			
Colloquiums		Oral exam			

	Written exam		Project			
Assessment and evaluation of student work	Preparation, implementation and analysis of experiments – 100 % (or final experimental exam – 80 %; creating worksheets, structuring experiments and experimental skills – 20 %).					
Required literature	Title				Number of copies available	Availability on other medium
	Sikirica, M. (2011). Zbirka kemijskih pokusa za osnovnu i srednju školu, Školska knjiga, Zagreb.					
	Chemistry textbooks applied by Ministry of science and education					
Supplementary literature	Sikirica, M. (2004). Metodika nastave kemije, Školska knjiga, Zagreb.					
Quality assurance	Personal consultations, individual tasks analysis, group conversation, institutional evaluation at the end of the semester.					
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 ☑ 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	Availability on other medium

		copies available	
	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)			

Subject name	Laboratory in Thermodynamics and Modern Physics		
ID	PMP014	Study year	3.
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	Compulsory	Online percentage	20%

Subject description	
Subject goals	Understanding the lows of thermodynamics through independent performance of selected experiments. Understanding and application of the detailed statistical analysis of experimental results.
Enrolment requirements	Acquired learning outcomes in thermodynamics and modern physics.
Learning outcomes	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.
Syllabus	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
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 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="6">Laboratory in Waves and Optics</td></tr>
<tr><td>ID</td><td>PMP013</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 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="6">Acquired learning outcomes in waves and optics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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="6">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>
<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">Writing reports on the conducted experiments. Attendance.</td></tr>
</table>

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)						

Subject name	Applied Statistics		
ID	PMIG10	Study year	2.
Lecturer	izv. prof. dr. sc. Goran Erceg Domagoj Jelić	Points value (ECTS)	6.0
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 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.		
Enrolment requirements	None.		
Learning outcomes	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.		
Syllabus	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). 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)							

Subject name	Primjena mikroskopijskih tehnika u prirodnim znanostima		
ID	PMB530	Study year	2.
Lecturer	prof. dr. sc. Ivana Bočina	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	5%

Subject description	
Subject goals	Cilj ovog predmeta je upoznati mogućnosti i izazove svjetlosne i elektronske mikroskopije u prirodnim znanostima. Studenti će naučiti o primjenama mikroskopijskih tehnika u prirodnim znanostima. Studenti bi trebali biti sposobni pripremiti uzorak za mikroskopiju, kao i obraditi i analizirati sliku dobivenu mikroskopijskim tehnikama.
Enrolment requirements	Nema uvjeta.
Learning outcomes	Nakon odslušanog predmeta bi trebali biti u mogućnosti: 1. Objasniti osnove mikroskopskih tehnika. 2. Objasniti kako se mogu koristiti mikroskopske tehnike. 3. Opisati i objasniti važnost mikroskopskih tehnika u znanosti. 4. Imenovati i objasniti metode u svjetlosnoj mikroskopiji. 5. Objasniti razlike između svjetlosne i elektronske mikroskopije. 6. Pripremite uzorak za svjetlosnu i elektronsku mikroskopiju. 7. Obraditi i analizirati sliku.
Syllabus	PREDAVANJA: – Uvod u mikroskopiju. Svjetlosna mikroskopija. Elektronska mikroskopija. (3 sata) – Fluorescentna mikroskopija. Imunohistokemija i imunofluorescencija. (3 sata) – Osnovne histološke tehnike u prirodnim znanostima. (3 sata) – Mikrofotografija kao izvor informacija u biologiji. (3 sata) – Transmisijska elektronska mikroskopija u prirodnim znanostima (3 sata) VJEŽBE: Priprema uzoraka za mikroskopiju: izolacija tkiva i organa, fiksacija tkiva, dehidracija, bistrenje tkiva, impregnacija tkiva, uklapanje tkiva, rezanje tkivnih blokova, bojanje. (15 sati)

Teaching types			
	[x] Lectures [ ] Seminars [ ] Exercises [ ] Fully online [x] Combined online	[ ] Fieldwork [ ] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring	[ ] [ ] [ ] [ ]
Student obligations			

Monitoring student work						
	Class attendance	0.5	Research		Practical work	
	Experimental work	1	Paper			

	Essay		Seminar paper			
	Colloquiums	0.5	Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	Student će biti ocijenjen temeljem prezentacije seminarskog rada i pisanog testa.					

Required literature	Title	Number of copies available	Availability on other medium
	Nastavni materijal pripremljen od predmetnih nastavnika		
	Saraga-Babić M, Sapunar D, Puljak L, Vukojević K, Lovrić Kojundžić S, Carev D. Histology Atlas. Virtual Medical School, 2007. http://www.vms.hr/HistologyAtlas/index.htm		
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	Application of Programming in Physics		
ID	PMP074	Study year	1.
Lecturer	izv. prof. dr. sc. Toni Šćulac doc. dr. sc. Marin Vojković	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	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.
Enrolment requirements	None.
Learning outcomes	• 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.
Syllabus	(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 (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	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐

<table>
<tr><td>Student obligations</td><td colspan="6">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.</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>1.5</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>1.5</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 solutions to exercise tasks and the final seminar paper are being evaluated.</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">Harvey Gould, Jan Tobochnik, and Wolfgang Christian „An Introduction to Computer Simulation Methods Applications to Physical System“, Addison-Wesley, 2006.</td><td></td><td></td></tr>
<tr><td colspan="4">A. B. Shiflet and G. W. Shiflet "Introduction to computational science", Princeton University Press, 2006.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">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.</td></tr>
<tr><td>Quality assurance</td><td colspan="6">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="6"></td></tr>
</table>

<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>☑ Lectures
☑ Seminars
☑ Exercises
☐ Fully online
☐ Combined online</td><td>☐ Fieldwork
☑ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</td><td colspan="4">☑
Predavanja korištenjem prezentacija i rasprava sa studentima.
☑
Rješavanje odabranih</td></tr>
</table>

			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)			

Subject name	Natural toxins in the sea		
ID	PPC210	Study year	3.
Lecturer	izv. prof. dr. sc. Stjepan Orhanović	Points value (ECTS)	2.0
Associates		Class execution (number of hours in semester)	L: 15, S: 0, E: 0, P: 0
Subject status	Elective	Online percentage	10%

Subject description	
Subject goals	Course objective is acquiring knowledge about various sources of toxicity originating in the sea and their influence on the human health
Enrolment requirements	None
Learning outcomes	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
Syllabus	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)
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Attending classes and preparing seminar as a PPT presentation.

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	Power point presentation on the chosen subject with reflection on the causes, influence, frequency and spatial distribution of intoxication and related analytical methods		
Required literature	Title	Number of copies available	Availability on other medium
	Scientific articles on the subject presented		
Supplementary literature			
Quality assurance	Personal consultations, students survey for the evaluation of the subject and teacher, evidence of the presence on the classes.		
Other (in the opinion of the proponent)			

Subject name	Mobile Applications Programming		
ID	PMID35	Study year	2.
Lecturer	izv. prof. dr. sc. Goran Zaharija	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	25%
Subject description			
Subject goals	The goal of the course is to introduce main concepts related to the design and development of the applications for mobile phone platforms. Describe several main environments and development platforms for mobile development. Students will during the course develop their own simple mobile application using appropriate tools and development environments.		
Enrolment requirements	Basic knowledge of programming concepts with the focus on OOP paradigm. Basic knowledge of HTML, CSS and JavaScript		
Learning outcomes	After finishing the course, students will be able to: Describe the difference between classic and mobile applications. Define the basic structure of mobile application. Recognize the main challenges in mobile application development (screen sizes, memory constraints, CPU) and how to address them. Design and develop their own simple application. Describe the complete process of mobile application development – design, development, testing and deployment.		
Syllabus	1. Mobile application development basics (2+2). 2. Overview of mobile platforms (iOS, Android, Mobile 8) (2+2). 3. Developing Cross-platform mobile applications(2+2). 4. Introduction to the development environment (2+2). 5. Building a simple mobile application (2+2). 6. User Interface design (2+2). 7. Life-cycle of different application parts (2+2). 8. Handling data in mobile applications (2+2). 9. Resource management and permissions (2+2) 10. Event handling (touchscreen, gestures, device orientation) (1/2) (2+2). 11. Event handling (touchscreen, gestures, device orientation) (2/2) (2+2). 12. Project discussion and design. (2+2). 13. Project – development (2+2). 14. Project – testing (2+2). 15. Project – final presentation (2+2).		
Teaching types	☑ Lectures ☐ Seminars ☐ Exercises ☐ Fully online ☑ Combined online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring	☑ Domaće zadaće ☐ ☐ ☐
Student obligations	Lecture and laboratory attendance, active participation in course activities, homework and project realization, final exam.		

Monitoring student work	Class attendance	1	Research		Practical work	1
	Experimental work		Paper		Domaće zadaće	0.5
	Essay		Seminar paper			
	Colloquiums		Oral exam	1		
	Written exam	0.5	Project	1		
Assessment and evaluation of student work	Class attendance (10%) Final project (45%) Oral exam (45%)					

Required literature	Title	Number of copies available	Availability on other medium
	Lee, Schneider, and Schell, Mobile Applications: Architecture, Design, and Development, Prentice Hall, 2004.		
	Brian Fling, Mobile Design and Development, O'Reilly Media, 2009		
Supplementary literature	Course materials available online		
Quality assurance	Student discussion, anonymous student evaluation questionnaire, student success rate, self-assessment		
Other (in the opinion of the proponent)			

Subject name	Network Application Programming		
ID	PMIC60	Study year	3.
Lecturer	izv. prof. dr. sc. Goran Zaharija Dino Nejašmić, pred.	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	0%
Subject description			
Subject goals	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.		
Enrolment requirements	Basic knowledge of programming.		
Learning outcomes	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		
Syllabus	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) 13. Security challenges in web application (2h) 14. Project (2h)		
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises	☐ Fieldwork ☑ Individual assignments ☐ Multimedia	☐ ☐ ☐

	☐ Fully online ☐ Combined online	☐ Laboratory ☐ Mentoring	☐

Student obligations	The course is conducted according to the model of integrated teaching and continuous student evaluation. Student obligations include: – attendance at lectures and exercises, – active participation in teaching activities, – solving short knowledge tests, – partial midterm exam during the semester, – homework, – project development and presentation, – partial final exam.

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

Assessment and evaluation of student work	Class attendance and short knowledge tests (20%) Project development and presentation (40%) Midterm and final exam (40%)

Required literature	Title	Number of copies available	Availability on other medium
	Osnove programiranja za web, Sveučilište u Splitu Filozofski fakultet, 2007. Lada Maleš, Saša Mladenović		
	JavaScript: The Definitive Guide, David Flanagan, O'Reilly (2011.)		
	Beginning ASP.NET 4.5 in C# Matthew MacDonald (2012.)		

Supplementary literature	Online Student material, including solutions to selected problems and additional reading
Quality assurance	Student discussion, anonymous student evaluation questionnaire, student success rate, self-assessment
Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="3">First Steps in Physics Research</td></tr>
<tr><td>ID</td><td>PMP153</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Petar Stipanović
prof. dr. sc. Mile Dželalija
doc. dr. sc. Lucija Krce
Josipa Šćurla</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: 0
S: 30
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">• osposobiti studente/ice za pripremanje i provođenje istraživački usmjerene nastave fizike
• osposobiti studente/ice za osmišljavanje i izradu radnih materijala za istraživački usmjerenu nastavu fizike
• osposobiti studente/ice za vrednovanje učeničkih postignuća tijekom istraživački usmjerene nastave fizike
• osposobiti studente/ice za kritičku (samo)refleksiju i (samo)vrednovanje odgojno-obrazovnog i istraživačkog rada</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">nema</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">• argumentirati odabir nastavne teme/sadržaja za istraživački usmjerenu nastavu
• pripremiti i provesti istraživački usmjereni nastavni sat fizike po danim materijalima
• u suradnji s fizičarima osmisliti, pripremiti i izraditi metodički oblikovanu nastavnu temu (sadržaj) za istraživački usmjerenu nastavu fizike
• u suradnji s fizičarima izraditi pripremu za istraživački usmjereni nastavni sat
• u suradnji s fizičarima izraditi nastavna sredstva za istraživački usmjereni nastavni sat
• vrednovati učenička postignuća tijekom (i nakon) istraživački usmjerene nastave fizike
• odabrati i primijeniti odgovarajuću informacijsko-komunikacijsku tehnologiju u svrhu unaprjeđivanja efikasnosti poučavanja i učenja
• provoditi kritičku (samo)refleksiju i (samo) vrednovanje istraživački usmjerene nastave fizike</td></tr>
<tr><td>Syllabus</td><td colspan="3">Predmet je koncepcijski podijeljen na tri dijela. U prvom se dijelu obrađuju teorijski i metodički koncepti istraživački usmjerene nastave fizike te pregled i primjena postojećih radnih materijala namijenjenih toj svrsi. Drugi dio kolegija predviđen je za samostalan rad studenata na osmišljavanju i izradi vlastitih metodički oblikovanih radnih materijala za istraživački usmjerenu nastavu fizike. U trećem dijelu predviđena je javna prezentacija napravljenih radnih materijala za istraživački usmjerenu nastavu fizike.
1. Istraživački usmjerena nastava fizike. Definicija. Povijesni razvoj. Karakteristike, metode i strategije istraživački usmjerene nastave fizike. Rješavanje problema.
2. Metodičko-didaktička načela pripreme i provedbe istraživački usmjerene nastave fizike.
3. Pregled postojećih materijala za provođenje istraživački usmjerene nastave fizike
4. Vrednovanje istraživački usmjerene nastave fizike - formativno, refleksija, samorefleksija i samovrednovanje
5. Izrada radnih materijala za istraživački usmjerenu nastavu. Smjernice. Karakteristike. Kvaliteta.</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></tr>
<tr><td>Student obligations</td><td colspan="3">• redovito prisustvovati nastavi
• predati napisane samostalne zadatke</td></tr>
</table>

	• osmisliti i izraditi radne materijale na danu temu • predati radne materijale u pisanom obliku (PDF i Word) • prezentirati radne materijale • aktivno sudjelovati na nastavi • pripremiti pitanja za diskusiju kao kritički prijatelj					
Monitoring student work	Class attendance	1	Research		Practical work	2
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	Studenti koji su redovito polazili nastavu (više od 90% sati), koji su prezentirali samostalne zadatke s prolaznom ocjenom i aktivno sudjelovali u diskusijama kao kritički prijatelji imaju pravo na potpis. Studentima koji su stekli pravo na potpis ocjena se formira na temelju bodova dobivenih na nastavi, bodova dobivenih za izrađeni radni materijal i bodova dobivenih za prezentaciju izrađenih radnih materijala. Samostalni zadaci Tijekom nastave studenti će dobiti nekoliko samostalnih zadataka čiji je ukupni udio u završnoj ocjeni 20%. Radni materijal Tijekom kolegija studenti će sami ili u timu izrađivati radni materijal za istraživački usmjerenu nastavu fizike. Predani radni materijal nosi 50% ukupne ocjene ovog kolegija. Prezentacija radnih materijala U trećem dijelu kolegija studenti će javno prezentirati svoje radne materijale, argumentirati zašto smatraju da su ti materijali stvarno materijali za istraživački usmjerenu nastavu, te sudjelovati kao kritički prijatelji u diskusijama na prezentacijama drugih studenata. Ukupni udio prezentacija radnih materijala u završnoj ocjeni je 30%. Za uspješno polaganje kolegija potrebno je imati više od 50% ukupnih bodova od čega više od pola na radnom materijalu.					

Required literature	Title	Number of copies available	Availability on other medium
	Priručnik za učitelje i nastavnike, Prvi koraci u istraživanju fizike - Gibanje, PMFST		
	Priručnik za učitelje i nastavnike, Prvi koraci u istraživanju fizike - Magneti, PMFST		
	Priručnik za učitelje i nastavnike, Prvi koraci u istraživanju fizike - Optika, PMFST		
Supplementary literature	• Zbornici radova susreta i kongresa nastavnika fizike • Zbornici radova stručno-metodičkih skupova Metodika nastave fizike u osnovnoj i srednjoj školi • relevantni znanstveni članci (tiskani ili elektronički oblik)		
Quality assurance	U zadnjem tjednu nastave iz ovog kolegija provodit će se anonimna anketa u kojoj će studenti evaluirati kvalitetu održane nastave.		
Other (in the opinion of the proponent)			

Subject name	Computational methods in physics		
ID	PMP073	Study year	3.
Lecturer	izv. prof. dr. sc. Toni Šćulac	Points value (ECTS)	4.0
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	Understand, adopt, and learn the algorithmic approach to problem-solving and writing simple computer programs. Understand, adopt, and learn the basic concept of programming from the perspective of programming instructions for data input, data processing, data storage, and distribution of processing results, with applications in physics. Understand, adopt, and learn the basic concept of data storage and reuse, with applications in physics.
Enrolment requirements	None.
Learning outcomes	After successfully completing the course, the student will be able to: 1.) Formulate algorithmic solutions to problems. 2.) Write programs in the Python programming language. 3.) Identify errors in program solutions. 4.) Develop and use computer programs for simulating physical models of complex systems, as well as for analyzing and presenting the obtained results.
Syllabus	1.) Introduction to the course. Algorithmic problem-solving. Program input and output. 2.) Types of variables, operators, branching. 3.) For and while loops. If conditions. 4.) Arrays, lists, and matrices. Functions and modules. 5.) Functions and modules. 6.) Application of existing modules in mathematics and physics. 7.) Development of algorithms for solving simple problems in physics. 8.) Multidimensional arrays. 9.) Data analysis and processing. Plotting graphs. 10.) Simple animations. 11.) Files. Reading and storing data. 12.) Dictionaries and lists. 13.) Objects and classes. The concept of object-oriented and functional programming. 14.) Application of computational methods in physics. 15.) Advanced application of computational methods in physics.
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. Participation and engagement in class, completion of tasks during class, completion of assignments at home, preparation of a seminar that includes independent numerical solving of a physical problem, writing a report on the

	process, and presenting the results.					
Monitoring student work	Class attendance	2	Research		Practical work	0.5
	Experimental work		Paper			
	Essay		Seminar paper	0.5		
	Colloquiums	1	Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	Student participation and attendance in class. Written component: 2 midterm exams. Preparation of student seminars, written report, and oral presentation.					

Continuous assessment

Evaluation elements	Performance (min)	Weight in grade (%)
Independent problem solving and oral presentation of results	50	40
Homework	25	20

Final assessment

Evaluation elements	Performance (min)	Weight in grade (%)
Preparation and presentation of a seminar	50	40

Evaluation

Points (%)	Criterion	Grade
0–49		1
50–59		2
60–74		3
75–89		4
90–100		5

Required literature	Title	Number of copies available	Availability on other medium
	M. Newman: Computational Physics		
	C. Fuehrer, J.E. Solem, O. Verdier: Scientific Computing with Python 3		

Supplementary literature	Lecture slides.
Quality assurance	Discussion with students, anonymous student survey, student performance in the course, self-analysis.

Other (in the opinion of the proponent)	

<table>
<tr><td>Subject name</td><td colspan="6">Computer vision</td></tr>
<tr><td>ID</td><td>PMII60</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Barbara Džaja</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">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.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Course enrolment requirements: none.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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</td></tr>
<tr><td>Syllabus</td><td colspan="6">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
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</td></tr>
</table>

	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
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☑ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	Class attendance Independently preparation of exercise. Making exercise reports Independent planning and presentation of student paper Active participation in the teaching process Exam.

Monitoring student work

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

Assessment and evaluation of student work	Total scoring (100%): Exam or 2 colloquiums – 80%, student paper 10%, exercises 10% 1. Colloquium 1: 40% (or exam) 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)

Required literature

Title	Number of copies available	Availability on other medium

	Obrada slika i računalni vid, interna skripta.		
	Ramesh Jain, Rangachar Kasturi, Brian G.Schunck, Machine Vision, McGraw-Hill, 1995.		
	Prezentacije s predavanja		
Supplementary literature	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.		
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="3">Computer aided product design (CAD)</td></tr>
<tr><td>ID</td><td>PMT112</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Ivan Peko</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>0%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">– Familiarize participants with computer-aided product design (CAD) with special emphasis on 3D modeling
– Develop skills for 3D design of various models and assemblies in various fields of application: industry, science, education
– Develop skills for computer-supported simulations based on designed models and assemblies
– Develop the ability to apply computer-aided 3D design in creating innovative products in various industries.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">– None.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">– Search and analyze literature on computer-aided design (CAD) of models and assemblies
– Analyze the function and application of computer-aided 3D design in modern industry, product development and optimization
– Apply CAD in the creation of computer 3D models, assemblies and simulations
– Apply CAD in parametric 3D modeling
– Analyze and validate geometric 3D models and assemblies
– Evaluate tools and procedures in computer-aided product design
– Connect 3D computer-supported design with other advanced digital technologies: 3D printing, 3D scanning, artificial intelligence, machine learning...</td></tr>
<tr><td>Syllabus</td><td colspan="3">1. Introduction to computer-aided design
2. Historical development of technology
3. Overview of softwares used for 3D computer-aided product design
4. Phases of the computer-aided 3D product design process
5. Parametric 3D modeling
6. Creation of 3D assemblies
7. Computer-supported 3D simulations
8. 3D modeling with surfaces
9. Optimization of 3D models (Generative shape design)
10. Additive technologies (3D printing technologies)
11. Connecting 3D design with other advanced digital technologies: 3D scanning, 3D printing, artificial intelligence (AI), Internet of Things (IoT)...
12. Application of CAD 3D product design in the automotive industry, aerospace industry, machinery and equipment industry, shipbuilding, medical industry, etc.</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">Attending classes, active participation in the 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>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>1</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">2 midterms / exams
Grade = (K1 + K2)/2
(K1: result of 1st midterm, K2: result of 2nd midterm)
Grade by percentage: 50 – 62%: sufficient (2), 63 – 75%: good (3), 76 – 87%: very good (4), 88 – 100%: excellent (5)</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">Presentations from lectures and exercises</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">1. K. Lee, "Principles of CAD/CAM/CAE Systems", Addison-Wesley, USA 1999.
2. C. McMahon, J. Browne, “CADCAM: principles, practice and manufacturing management”, PrenticeHall, Harlow 1998.
3. S. Dogra, "Autodesk Fusion 360 – A Power Guide for Beginners and Intermediate Users", CADArtifex, 2020.
4. R. Shih, "Parametric Modeling with Autodesk Fusion 360 (Spring 2020 Edition)", SDC Publications, USA 2020.
5. S. Dogra, "Autodesk Fusion 360: Introduction to Surface and T-Spline Modeling", CADArtifex, 2021.
6. A. Gebhardt, JS. Hötter, "Additive Manufacturing – 3D Printing for Prototyping and Manufacturing", Hanser Publications, Cincinnati, 2016.
7. B. Redwood, F. Schöffer, B. Garret, "The 3D Printing Handbook -Technologies, design and applications", 3D Hubs, Amsterdam, 2017.
8. P. Kyratsis, A. Manavis, J. P. Davim, "Computational design and digital manufacturing", Springer, Cham, 2023</td></tr>
<tr><td>Quality assurance</td><td colspan="6">Conversation with students, student evaluation using an anonymous survey, student success in the exam, 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">Computational Physics with Industry Placements</td></tr>
<tr><td>ID</td><td>PMP2PR</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Petar Stipanović
prof. dr. sc. Leandra Vranješ Markić
prof. dr. sc. Ante Bilušić
prof. dr. sc. Mile Dželalija</td><td>Points value (ECTS)</td><td>30.0</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>15</td><td>0</td><td>0</td><td>0</td></tr></table></td></tr>
<tr><td>Subject status</td><td>Elective</td><td>Online percentage</td><td>50%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">• To improve academic performance and employability of physicists.
• To put computational physics knowledge and skills into practice in real industry world.
• To develop transversal employability skills required for the world of work, such as communication, problem-solving, team-working, commercial awareness, project management.
• To gain inside into how. certain industries operate and the challenges they face, and to try a career path.
• To improve employment prospects and helps students to develop professional skills that are of benefit for further study and future employment.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Enrolment to graduate study programme in Computational Physics</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">• apply physics theories to industrial practice
• manage research and development projects
• plan self organisation
• solve problems in industrial research
• communication, collaboration and creativity
• use analytics for commercial purposes
• develop professional network</td></tr>
<tr><td>Syllabus</td><td colspan="3">1. Introduction to the computational physics industry placement
2. Participation within the 14-week project work placement on specific computational topic at the Company
3. Preparation and presentation of the Seminar on experiences, activities and results at the industry placement (daily work; student reactions, opinion and feeling; suggestions made by colleagues and a tutor; progress made; further plans; reporting on each week employability competence developed)</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>☑ domaće zadaće
☐
☐
☐</td></tr>
<tr><td>Student obligations</td><td colspan="3">- Active participation at the introductory lectures in the classes with their comments, questions and answers to the questions
- Active participation at the project work in the Company
- prepare and present the project work at the company</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>28</td></tr></table></td></tr>
</table>

	Experimental work		Paper			
	Essay		Seminar paper	1		
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	– preparation and presentation of the seminar (60%) – report on the industry assignment by the company tutor (40%)					
Required literature	Title				Number of copies available	Availability on other medium
	Literature on the specific topic, depending on the agreed project between the Faculty/Department, Company and the student					da
Supplementary literature	Literature on the specific topic, depending on the agreed project between the Faculty/Department, Company and the student					
Quality assurance	– Analysis of learning outcomes at the end of the placement versus initial screening. – Monitoring student work and development – Visiting the Company on site while the student work – other student surveys					
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: 30, S: 0, E: 30, P: 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 seminar.

Monitoring student work						
	Class attendance	0.5	Research		Practical work	0.5
	Experimental work		Paper			
	Essay		Seminar paper	2		
	Colloquiums		Oral exam	0		
	Written exam	2	Project			

Assessment and evaluation of student work	Class attendance (20%), Seminar (40%), Exam(40%).

Required literature	Title	Number of	Availability on other medium

		copies available	
	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)			

<table>
<tr><td>Subject name</td><td colspan="6">Seminar in Physics Education</td></tr>
<tr><td>ID</td><td>PMP152</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">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>0</td><td>60</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 take account on pupil’s preconceptions and misconceptions within a lecture plan.
• To develop abilities for evaluation of conceptual knowledge.
• To gain an overview of influence of educational research on development of efficient teaching methods.
• To enable students to write seminar papers and essays independently.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">• Physics Education II</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">• To interpret ideas connected with certain physical phenomena.
• To qualitatively interpret physical phenomena.
• To assess the level of pupil’s conceptual understanding.
• To link knowledge through contextual problems.
• To use acquired knowledge in new contexts.
• To be able to use and analyze papers from educational physics journals.</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Pupil’s preconceptions in mechanics and difficulties in application of Newton’s laws.
2. Pupil’s difficulties in constructing and interpreting free body diagrams.
3. Pupil’s difficulties in understanding of non-inertial reference frames.
4. Concept of energy and difficulties in conceptual understanding.
5. Conservation of momentum and difficulties in conceptual understanding.
6. Difficulties in conceptual understanding of kinetic molecular theory of gases and structure of matter.
7. Fluid mechanics and difficulties in conceptual understanding.
8. Electrostatics and difficulties in conceptual understanding.
9. Pupil’s difficulties in interpreting concepts of electric circuits.
10. Electromagnetism and difficulties in conceptual understanding.
11. Wave optics and difficulties in conceptual understanding.
12. Pupil’s difficulties in interpreting concepts of quantum mechanics.
13. Teaching and learning with analogies.
14. Misconceptions through history of physics.
15. Development of pupil’s procedural and metacognitive knowledge.</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">☑ homework assignments
☐
☐
☐</td></tr>
</table>

<table>
<tr><td>Student obligations</td><td colspan="6">Attendance of at least 80% of seminar classes. At least two seminar essays written and presented.</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>0.5</td><td>Oral exam</td><td>0.5</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 of student work</td><td colspan="6">Student’s achievements and activities are graded as follows:
• Two written seminar essays – up to 30 points
• Two given lecture on seminar essay topics – up to 20 points
• Analysis and self-analysis of the given lectures – up to 5 points
• Attendance and class activity – up to 15 points
• Exam – up to 30 points
Final grade is given as follows:
• 89 – 100 points: excellent
• 76 – 88 points: very good
• 63 – 75 points: good
• 50 – 62 points: sufficient</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">E. Mazur, Peer Instruction: A User's Manual, Prentice Hall, 1997</td><td></td><td></td></tr>
<tr><td colspan="4">The physics classroom, http://www.physicsclassroom.com/</td><td></td><td></td></tr>
<tr><td colspan="4">Paper from journals: Am. J. Phys, Phys. Teach, Phys. Educ, Int. J. of Sci. Educ.</td><td></td><td></td></tr>
<tr><td colspan="4">Approved high and elementary school textbooks</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">B. Arons, Teaching Introductory Physics, John Wiley & Sons Inc. 1996.
E. F. Redish, Teaching Physics with the Physics Suite, John Wiley & Sons Inc. 2003.</td></tr>
<tr><td>Quality assurance</td><td colspan="6">• Evaluation of student achievements in accordance with expected outcomes
• Lecturer's self-evaluation
• Student feedback through questionnaires
• In-institution and out-institution review</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
</table>

Subject name	Symmetries in Physics		
ID	PMP274	Study year	1.
Lecturer	izv. prof. 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. 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.
Teaching types	[x] Lectures [ ] Seminars [x] Exercises [ ] Fieldwork [x] Individual assignments [ ] Multimedia

	Fully online Combined online		Laboratory Mentoring			
Student obligations	Lecture attendance >70%; Excercises attendance >70%.					
Monitoring student work	Class attendance	2	Research		Practical work	
	Experimental work		Paper		Independent work	2.7
	Essay		Seminar paper			
	Colloquiums	0.2	Oral exam	1		
	Written exam	0.1	Project			
Assessment and evaluation of student work	Two tests (midterm exams). Final exam.					
Required literature	Title				Number of copies available	Availability on other medium
	H. F. Jones, Groups, Representations and Physics, 2 nd edition, IOP Publishing, 1998					
	J. F. Cornwell, Group Theory in Physics, An Introduction, Academic Press, 1997					
Supplementary literature	W. Greiner, B. Müller, Quantum Mechanics – Symmetries, Second Edition, Springer Verlag, 1994 M. Hamermesh, Group Theory and Its Application to Physical Problems, Dover, 1989					
Quality assurance	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.					
Other (in the opinion of the proponent)						

Subject name	Complexity of algorithms		
ID	PMM920	Study year	2.
Lecturer	prof. dr. sc. Jurica Perić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 30, P: 0
Subject status	Compulsory	Online percentage	40%

Subject description	
Subject goals	Students will acquire knowledge in advanced algorithmic concepts. They will become familiar with designing efficient algorithms and precise analysis of their complexity.
Enrolment requirements	
Learning outcomes	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
Syllabus	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
Teaching types	[x] Lectures [ ] Seminars [x] 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	2.5		
	Written exam	1	Project			

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">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="3">Required literature</td><td>Title</td><td>Number of copies available</td><td>Availability on other medium</td></tr>
<tr><td>T. H. Cormen, C. E. Leiserson, R. L. Rivest, Introduction to Algorithms, MIT Press, Cambridge, Massachusetts, 1990.</td><td></td><td></td></tr>
<tr><td>D. Knuth, The Art of Computer Programming, Vol. 1, Fundamental Algorithms, Addison-Wesley, Reading, MA, USA, 1997.</td><td></td><td></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>

Subject name	Statistical Physics		
ID	PMP114	Study year	3.
Lecturer	prof. dr. sc. Larisa Zoranić	Points value (ECTS)	6.0
Associates		Class execution (number of hours in semester)	L: 45, S: 0, E: 30, P: 0
Subject status	Compulsory	Online percentage	5%
Subject description			
Subject goals	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.		
Enrolment requirements	Passed courses in General Physics I, II and Mathematics and completed courses in General Physics III and IV and Classical Mechanics		
Learning outcomes	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.		
Syllabus	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. 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	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online			☐ Fieldwork ☑ 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="3">STATISTIC</td></tr>
<tr><td>ID</td><td>PMM230</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>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>30%</td></tr>
<tr><td colspan="4">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="3">The objectives will be to achieve a deep understanding of particular statistical methods and to learn to use some advanced tools for analyzing and developing statistical methods.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="3">Successful completion of course „Probability I“ .</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">Upon successful completion of the requirements for this course, students should have the knowledge and skills to:
understand basic principles and concepts of mathematical statistics (sufficiency, efficiency, likelihood)
understand the basic principles of statistical inference and the issues they raise about how to do statistical inference.
be familiar with the common probability distributions that are used in statistical inference
understand and be able to carry out maximum likelihood estimation and inference in simple statistical models
understand and explain the different uses of randomization in statistics
be able to know what drawing a random sample from a population means and why it is important
be able to estimate the value of various population parameters from a sample of data
understand regression models
be able to apply linear regression and evaluate its efficiency</td></tr>
<tr><td>Syllabus</td><td colspan="3">Introduction. Examples of statistical problems. Statistical data types. Discrete statistical data types. Continuous statistical data types. CDF and density function. Graphical representation.
Introduction to Mathematical Statistics. Sufficient statistics. Factorization criterion. Equivalent statistics. Location Families. Examples.
Exponential family. Likelihood. Fisher information. Pivotal quantities. Examples.
Point estimators. Unbiased estimation. Uniform minimum variance unbiased (UMVU) estimator. Examples.
Efficient estimators. Maximum likelihood estimators. Examples.
Confidence set. Confidence interval. Construction of confidence intervals by pivot quantities. Asymptotic confidence intervals. Examples.
Hypothesis testing. Basic concepts (test, statistical test). Comparison of statistical test (errors, power, ...).
Constructing statistical tests. z-test. t-test. Likelihood ratio tests. Significance. Examples.
Regression analysis. Classical linear regression. Least squares. Multivariate linear regression. Matrix algebra.
Gauss - Markov theorem. Testing hypothesis about slope. Multicollinearity.
Model validation. Confidence intervals. Prediction intervals. Examples.
Rank based statistics. Mann-Whitney-Wilcoxon test. Wilcoxon signed-rank test.
Resampling. Permutation tests. Bootstrap.</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>

Student obligations	Students are expected to be present for every lecture and exercise section.					
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	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			
	Ivo Ugrina, Uvod u matematičku statistiku, skripta					
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. 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.					
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	STATISTICS		
ID	PMM861	Study year	1.
Lecturer	izv. prof. dr. sc. Goran Erceg Domagoj Jelić	Points value (ECTS)	4.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 15, P: 0
Subject status	Compulsory	Online percentage	60%

Subject description

Subject goals	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).
Enrolment requirements	Elementary knowledge of calculus and operations with sets.
Learning outcomes	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.
Syllabus	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)
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	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)			

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: 30, S: 0, E: 30, P: 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	☐ Fieldwork ☑ Individual assignments	☐ ☐

	☑ Exercises ☐ Fully online ☐ Combined online			☐ 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)			

Subject name	English for Specific Purposes I					
ID	PMS250	Study year	1.			
Lecturer	Ana Mršić Zdilar, v. pred.	Points value (ECTS)	2.0			
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	– to acquire insight into basic translation procedures of texts related to mathematics, computer science, polytechnics and physics – to develop reading skills and techniques in order to understand scientific and technical texts in English – to encourage the learning of terminology related to mathematics, computer science, polytechnics and physics – to revise and extend the knowledge of English grammar, especially related to technical and scientific texts – to develop students' written and oral communication skills in English					
Enrolment requirements	Four years of high school education, English language being the first or second foreign language.					
Learning outcomes	After attending the classes and passing the exam, students should be able to: – understand a text in English and translate it into Croatian – analyse the language features and the content of a technical text in English – give an oral presentation related to mathematics, computer science, polytechnics and physics in English – write a short text in English covering science related topics – successfully search for relevant technical literature and use it with the help of acquired lexical competence – understand different language structures and use them correctly (e.g. the passive voice, non-defining relative clauses, compound words etc.)					
Syllabus	1.Introduction to mathematics and numbers / Mathematics and numbers / The number system /Sets of numbers 2. Mathematical symbols/Irregular plurals 3. Fractions / Ratio, proportio and percentage / Using percentages in statistics 4. Power and roots / Word transformation 5. Factors 6. Introduction to computer science terminology 7. Computer applications / What can computers do?/What is a computer/ The Passive Voice 8. What's inside a microcomputer /Relative clauses /Word building-prefixes 9. Input devices /About the keyboard /Point and click / Word building- Adding a suffix 10. Output devices /Types of printers / Comparison of adjectives 11. Storage devices / Optical disks: pros and cons / Connectors and modifiers					

	12. Physics 13. Matter and measurement /Opposites 14. Liquids 15. Gases / Conditional clauses					
Teaching types	☐ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring		☐ ☐ ☐ ☐	
Student obligations	Students are expected to attend the classes regularly and participate actively in classes. They are also expected to give an oral presentation on a course related topic in English and pass two preliminary exams or a written exam.					
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	Regular attendance, participation in classes, oral presentation, two preliminary exams.					

Required literature	Title	Number of copies available	Availability on other medium
	Ferčec, Ivanka: A Course in Scientific English, Odjel za matematiku, Sveučilište u Osijeku, Osijek, 2001.		

Supplementary literature	Fabre, E. M./ Esteras, S. R.: Professional English in Use (Intermediate to advanced), Cambridge University Press, Cambridge 2007. Allen, J. P. B i Widdowson, H. G.: English in Physical Science, Oxford University Press, 1978.Glendinning, E. H.: English in Mechanical Engineering, Oxford University Press, 1979.
Quality assurance	Consultations, discussion, active participation, evaluation.
Other (in the opinion of the proponent)	No

Subject name	English for Specific Purposes I		
ID	PMS252	Study year	1.
Lecturer	Ana Mršić Zdilar, v. pred.	Points value (ECTS)	2.0
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	– 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		
Enrolment requirements	Četverogodišnje srednjoškolsko obrazovanje s engleskim jezikom kao prvim ili drugim stranim jezikom.		
Learning outcomes	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.) .		
Syllabus	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 13. Purification of Water 14. Oxygen/ Hydrogen 15. Atomic Structure I/II		
Teaching types	☐ Lectures ☑ Seminars ☐ Exercises	☐ Fieldwork ☐ Individual assignments ☐ Multimedia	☐ ☐ ☐

	Fully online Combined online		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.					

Subject name	English for Specific Purposes II		
ID	PMS251	Study year	1.
Lecturer	Ana Mršić Zdilar, v. pred.	Points value (ECTS)	2.0
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	– to acquire insight into basic translation procedures of texts related to mathematics, computer science, polytechnics and physics – to develop reading skills and techniques in order to understand scientific and technical texts in English – to encourage the learning of terminology related to mathematics, computer science, polytechnics and physics – to revise and extend the knowledge of English grammar, especially related to technical and scientific texts – to develop students' written and oral communication skills in English		
Enrolment requirements	Four years of high school education, English language being the first or second foreign language.		
Learning outcomes	After attending the classes and passing the exam, students should be able to: – understand a text in English and translate it into Croatian – analyse the language features and the content of a technical text in English – give an oral presentation related to mathematics, computer science, polytechnics and physics in English – write a short text in English covering science related topics – successfully search for relevant technical literature and use it with the help of acquired lexical competence understand different language structures and use them correctly (e.g. the passive voice, non-defining relative clauses, compound words etc.)		
Syllabus	1.Equations and formulae 2. Lines and angles 3. Two-dimensional figures / The triangle/ The circle /More 2-dimensional figures 4. Three-dimensional figures 5. Force 6. Motion 7. Work, energy and power 8. Health and safety / Computer ergonomics / Electronic rubbish / The risks of using mobiles and in-car computers 9. Operating systems and the GUI 10. Graphics and design / Multimedia 11. Sound and music /Audio files on the Web / Digital audio players / Other audio applications 12. Computers and work / Jobs in computing / Computers and jobs: new ways, new profiles /E-commerce 13. Web design / HTML / Basic elements / Video, animations and sound/Chatting and video conferences 14. Internet security /Internet crime		

	/Malware: viruses, worms, trojans and spyware /preventive tips 15. Robots, androids, AI /Robots and automata /Uses for robots/ Artificial Intelligence/Inteligent homes
Teaching types	☐ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	Students are expected to attend the classes regularly and participate actively in classes. They are also expected to give an oral presentation on a course related topic in English and pass two preliminary exams or a written exam.

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	Regular attendance, participation in classes, oral presentation, two preliminary exams.

Required literature

Title	Number of copies available	Availability on other medium
Ferčec, Ivanka: A Course in Scientific English, Odjel za matematiku, Sveučilište u Osijeku, Osijek, 2001.		
Fabre, E. M./ Esteras, S. R.: Professional English in Use (Intermediate to advanced), Cambridge University Press, Cambridge 2007.		

Supplementary literature	Allen, J. P. B i Widdowson, H. G.: English in Physical Science, Oxford University Press, 1978. Glendinning, E. H.: English in Mechanical Engineering, Oxford University Press, 1979.
Quality assurance	Consultations, discussion, active participation, evaluation.
Other (in the opinion of the proponent)	

Subject name	English for Specific Purposes (II)		
ID	PMS253	Study year	1.
Lecturer	Ana Mršić Zdilar, v. pred.	Points value (ECTS)	2.0
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	– 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
Enrolment requirements	Četverogodišnje srednjoškolsko obrazovanje s engleskim jezikom kao prvim ili drugim stranim jezikom
Learning outcomes	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
Syllabus	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 13. Ionization II 14. Acids 15. Bases
Teaching types	☐ Lectures ☑ Seminars ☐ Exercises ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ ☐ ☐

	☐ Fully online ☐ Combined online		☐ 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						
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		

Subject name	Light and Photosynthesis in the Sea		
ID	PMP26G	Study year	1.
Lecturer	izv. prof. dr. sc. Žarko Kovač	Points value (ECTS)	4.0
Associates		Class execution (number of hours in semester)	L: 30, S: 20, E: 0, P: 0
Subject status	Elective	Online percentage	0%

Subject description

Subject goals	– 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
Enrolment requirements	– Mathematical methods of physics II – Differential equations – Programming
Learning outcomes	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.
Syllabus	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) 11. Critical turbulence theory (2 hours of lectures) 12. Spectral effects (2 hours of lectures)
Teaching types	[x] Lectures [x] Seminars [x] Exercises [ ] Fully online	[ ] Fieldwork [x] Individual assignments [ ] Multimedia [ ] Laboratory	[ ] [ ] [ ] [ ]

	☐ Combined online		☑ 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)	

Subject name	Text and Graphical Programs for Physicists		
ID	PMP071	Study year	1.
Lecturer	doc. dr. sc. Marin Vojković	Points value (ECTS)	1.0
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	Ability to use Gnuplot. Ability to use LaTeX.		
Enrolment requirements	None.		
Learning outcomes	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...		
Syllabus	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.		
Teaching types	☐ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐

Student obligations	Attendance and commitment of students in class, making assignments with help and independently in class or at home.					
Monitoring student work	Class attendance	0.7	Research		Practical work	0.3
	Experimental work		Paper			
	Essay		Seminar paper			
	Colloquiums		Oral exam			
	Written exam		Project			
Assessment and evaluation of student work	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)					

Required literature	Title	Number of copies available	Availability on other medium
	[1] Š. Ungar, Not so short introduction to TeX with emphasis on LaTeX2ε, University of Osijek, Department of Mathematics, Osijek 2002. (web)		
	[2] Instructions that come with the Gnuplot software package.		

Supplementary literature	[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.
Quality assurance	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. 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	Fundamental Concepts in Physics					
ID	PMP106	Study year	3.			
Lecturer	izv. prof. dr. sc. Bernarda Lovrinčević	Points value (ECTS)	3.0			
Associates		Class execution (number of hours in semester)	L	S	E	P
			30	15	0	0
Subject status	Elective	Online percentage	50%			
Subject description						
Subject goals	Understanding the conceptual foundations of mechanics, fluid mechanics, waves and thermodynamics. Acquiring operational knowledge in solving numerical problems. Achieving the skill of reducing a physical problem into an appropriate mathematical model using equations.					
Enrolment requirements	Enrolled in Undergraduate Studies.					
Learning outcomes	1. demonstrate knowledge of motion kinematics in one, two and three dimensions; 2. state and explain Newton's laws of motion and apply them in numerical examples; 3. explain the concepts of work, kinetic and potential energy, momentum of force and momentum and apply the laws of conservation of energy and conservation of momentum in specific examples; 4. demonstrate knowledge of the kinematics and dynamics of rigid body rotation and solve problems involving rigid body rotation; 5. explain the concept of hydrostatic pressure and buoyancy and apply the continuity equation and the Bernoulli equation in numerical examples; 6. explain a simple harmonic oscillator and describe the formation and propagation of waves, the occurrence of wave interference, wave resonance and the Doppler effect; 7. state and explain the basic laws of thermodynamics, define the concept of heat and describe the mechanisms of heat transfer.					
Syllabus	1. Motion along a straight line. 2. Motion in two and three dimensions. 3. Force and Newton's laws. 4. Application of Newton's laws. 5. Work and kinetic energy. 6. Potential energy and the law of energy conservation. 7. Momentum and collisions. 8. Rigid body rotation. 9. Equilibrium conditions and their application. 0. Fluid mechanics. 11. Oscillations. 12. Waves. 13. Solids and fluids. 14. Heat and heat transitions. 15. Fundamentals of thermodynamics.					
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐			

Student obligations	Attending lectures and seminars, at least 70% of lectures and 80% of seminars. Write a seminar paper on the selected topic and present it in the form of a presentation to colleagues and the teacher. Solve at least 50% of the written exam.					
Monitoring student work	Class attendance	0.5	Research		Practical work	
	Experimental work		Paper		Seminari	0.5
	Essay		Seminar paper	1		
	Colloquiums		Oral exam			
	Written exam	1	Project			
Assessment and evaluation of student work	1. Seminar paper (written part) – 25% of the grade 2. Seminar paper (presentation) – 25% of the grade 3. Written exam – 50% of the grade					
Required literature	Title	Number of copies available	Availability on other medium			
	D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics. 9th Edition, John Wiley, New York 2011.					
Supplementary literature	1. P. G. Hewitt, Conceptual Physics, 12th Edition, Pearson 2010. 2. H. D. Young, R. A. Freedman, Sears and Zemansky's University Physics, 12th Edition, Pearson, 2008.					
Quality assurance	Exam results statistics and student evaluation through a survey conducted by the University of Split.					
Other (in the opinion of the proponent)						

Subject name	Fundamental Concepts in Quantum Physics		
ID	PMP11C	Study year	2.
Lecturer	izv. prof. dr. sc. Toni Šćulac	Points value (ECTS)	4.0
Associates		Class execution (number of hours in semester)	L: 30, S: 15, E: 0, P: 0
Subject status	Elective	Online percentage	20%

Subject description

Subject goals	Razvijanje konceptualnog razumijevanja kvantne mehanike
Enrolment requirements	Opće fizike
Learning outcomes	Razumjeti i objasniti: Koji su problemi klasične fizike doveli do razvoja kvantne fizike? Što su spregnutost i nelokalnost? Koji su problemi kvantnog mjerenja? Koji su makroskopski kvantni fenomeni?
Syllabus	Toplinski kapaciteti, zračenje crnog tijela. Kvantno mjerenje EPR paradoks i Bellove nejednakosti. Kvantna statistika. Laseri. Supravodljivost.
Teaching types	☑ Lectures ☑ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring
Student obligations	

Monitoring student work

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

Assessment and evaluation of student work	Seminarski rad i završni ispit

Required literature

Title	Number of copies available	Availability on other medium

	Jim Bagot: Beyond Measure, Oxford 2004.		
	Tim Maudlin: Quantum Non-Locality & Relativity, Wiley 2011.		
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	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
Student obligations	Class attendance and one seminar paper.

Monitoring student work

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

	Written exam		Project			
Assessment and evaluation of student work	Seminar paper and the final oral exam.					

Required literature	Title	Number of copies available	Availability on other medium
	Douglas R. Stinson: Combinatorial designs. Constructions and analysis		
Supplementary literature	Beth, Jungnickel, Lenz: Design Theory, Volume 1		
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	Graph theory		
ID	PMM806	Study year	3.
Lecturer	doc. dr. sc. Tanja Vojković	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	30%

Subject description	
Subject goals	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..
Enrolment requirements	Entry competences: Students should be familiar with basic concepts of linear algebra.
Learning outcomes	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
Syllabus	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)
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	1		

<table>
<tr><td></td><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">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.</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">A. Golemac, Osnove teorije grafova, skripta, PMF, Split, 2014.</td><td></td><td></td></tr>
<tr><td colspan="4">D. Veljan, Kombinatorna i diskretna matematika, Algoritam, Zagreb, 2001</td><td></td><td></td></tr>
<tr><td colspan="4">D. Veljan, Kombinatorika s teorijom grafova, Školska knjiga, Zagreb, 1989.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="6">J. Matoušek, J. Nešetril, Invitation to Discrete Mathematics, Oxford University Press, Oxford, 1998.
R.J. Wilson, Introduction to Graph Theory, Longman, Harlow, Essex, 1999.</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>

<table>
<tr><td>Subject name</td><td colspan="3">Relativity</td></tr>
<tr><td>ID</td><td>PMP401</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Toni Šćulac</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 colspan="2">☐ Fieldwork
☐ Individual assignments
☐ Multimedia
☐ Laboratory
☐ Mentoring</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>

<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. Marija Bliznac Trebješanin</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)
-Well-ordered sets. Ordinal numbers. Transfinite induction. The Buralli-Forti paradox. (2)
-Number classes. Statement equivalent to the Axiom of choice. (2)</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	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)						

Subject name	Thermodynamics		
ID	PMP007	Study year	2.
Lecturer	prof. dr. sc. Ante Bilušić	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	20%
Subject description			
Subject goals	Understanding the concepts and laws of thermodynamics and their application.		
Enrolment requirements	Acquired content from mathematical analysis, mechanics, and electricity and magnetism.		
Learning outcomes	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.		
Syllabus	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 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	[x] Lectures [x] Seminars [x] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [ ] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring [x] 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="3">Irreversible Process Thermodynamics</td></tr>
<tr><td>ID</td><td>PMP20C</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Larisa Zoranić</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><table><tr><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></table></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">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="3">Outcomes of undergraduate studies, especially related to equilibrium thermodynamics, statistical physics and classical mechanics.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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="3">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
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.</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	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	Toxicology		
ID	PPC209	Study year	3.
Lecturer	izv. prof. dr. sc. Viljemka Bučević Popović	Points value (ECTS)	2.0
Associates		Class execution (number of hours in semester)	L: 30 S: 0 E: 0 P: 0
Subject status	Elective	Online percentage	10%
Subject description			
Subject goals	Getting acquainted with the basic principles of toxicology and the toxicological properties of selected groups of harmful substances.		
Enrolment requirements	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		
Learning outcomes	After completing the course, the student will be able to: 1. Compare the main pathways for absorption of toxic substances into the human body, their distribution, metabolism and excretion. 2. Interpret dose and effect ratio, distinguish acute from chronic toxicity, classify harmful substances according to toxicological data 3. Assess the toxicity of different groups of substances (gases, solvents, metals, etc.) 4. Apply protective measures against chemicals in laboratory work 5. Discuss effects of potentially harmful substances in the everyday environment (pesticides, natural toxins, nutritional supplements, etc.)		
Syllabus	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) 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	1.0	Research		Practical work	
	Experimental work		Paper			
	Essay		Seminar paper	0.25		
	Colloquiums		Oral exam	0.75		
	Written exam		Project			
Assessment and evaluation of student work	Seminarski rad – 20% Usmeni ispit – 80%					

Required literature	Title	Number of copies available	Availability on other medium
	Lectures as pdf files.		
	Sutlović i sur., Toksikologija hrane, Redak, 2011.		
	Duraković i sur., Klinička toksikologija, Grafos, 2000.		
Supplementary literature	Sutlović i sur., Osnove forenzične toksikologije, Redak, 2011. Plavšić, Žuntar, Uvod u analitičku toksikologiju, Školska knjiga, 2006. 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)			

<table>
<tr><td>Subject name</td><td colspan="3">Toxicology</td></tr>
<tr><td>ID</td><td>PMB735</td><td>Study year</td><td>2.</td></tr>
<tr><td>Lecturer</td><td>izv. prof. dr. sc. Viljemka Bučević Popović</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: 30
S: 0
E: 0
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">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="3">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="3">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="3">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)
13. Protection measures against harmful chemicals in laboratory. (2 hours)
14. Selected examples of exposures to harmful substances in everyday life. (4 hours)</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></tr>
<tr><td>Student obligations</td><td colspan="3">Attending classes, seminar on selected topic, exam</td></tr>
</table>

Monitoring student work	Class attendance	1.0	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	20% seminar 80% exam					
Required literature	Title				Number of copies available	Availability on other medium
	Lectures as pdf files.					
	Sutlović i sur., Toksikologija hrane, Redak, 2011					
	Duraković i sur., Klinička toksikologija, Grafos, 2000.					
Supplementary literature	Sutlović i sur., Osnove forenzične toksikologije, Redak, 2011. Plavšić, Žuntar, Uvod u analitičku toksikologiju, Školska knjiga, 2006. 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)						

<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>doc. dr. sc. Anna Alajbeg</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">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)
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)</td></tr>
</table>

	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)	

Subject name	Uvod u biofiziku stanice						
ID	PMB711	Study year	2.				
Lecturer	prof. dr. sc. Larisa Zoranić	Points value (ECTS)	3.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			30	5	10	0	
Subject status	Elective	Online percentage	10%				
Subject description							
Subject goals	Basic understanding of biophysics, models of biological macromolecules and biological processes, described through the ideas of classical mechanics, thermodynamics and statistical mechanics.						
Enrolment requirements	Molecular biology, biochemistry, basics of physics						
Learning outcomes	On completion of this course, a student should be able to: 1. recognize the ideas and importance of a quantitative approach in biology 2. describe the basis of thermodynamics and statistical mechanics through examples from biophysics 3. describe some of the mechanical models used in the description of biological systems 4. explain some of the biological processes using physical models						
Syllabus	Weekly class schedule: 1. Introduction to biophysics. Spatio-temporal scales of biological systems. 2. Basic models in biophysics.3. Mechanical and chemical equilibrium in a cell. 4. Free energy. Configuration energy. 5. Statistical description of biological systems. Entropy. Models of two states. 6. Ligand-receptor binding. Hill's equation. ATP hydrolysis. 7. Water as the most important biological solvent. pH. 8. Description of the structure of biological macromolecules - polymer model. 9. Protein folding. Hydrophobic effect and hydrophobic force 10. Models of biological membranes. Spring model. 11. Dynamics in cells. Diffusion. 12. Models of chemical reactions. 13. Enzyme kinetics. Michaelis-Menten model. 14.-15. Project-oriented teaching - depending on the chosen topics, examples: hemoglobin, charges in the cell, osmosis.						
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐				
Student obligations	Attendance, student commitment in class, problem solving and seminars.						
Monitoring student work	Class attendance	1	Research		Practical work		
	Experimental work		Paper				
	Essay		Seminar paper	0.5			

	Colloquiums		Oral exam	1		
	Written exam		Project	0.5		
Assessment and evaluation of student work	Commitment, preparation of homework and seminars, participation in the project part of teaching, and oral exam are assessed.					

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.	2	online
	Molekularna biofizika , Antonio Šiber , skripta, 2012.		online

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

<table>
<tr><td>Subject name</td><td colspan="3">Introduction to differential geometry</td></tr>
<tr><td>ID</td><td>PMM120</td><td>Study year</td><td>3.</td></tr>
<tr><td>Lecturer</td><td>doc. dr. sc. Tea Martinić Bilać</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>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">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="3">Required competences: knowledge of mathematical analysis and linear algebra.</td></tr>
<tr><td>Learning outcomes</td><td colspan="3">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="3">-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)

-First fundamental form of surface. (2)

-Orientation of surface (1)

-Second fundamental form of surface. (2)</td></tr>
</table>

	-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 available	Availability on other medium
	N. Ujević, Predavanja iz uvoda u diferencijalnu geometriju, skripta.						
Supplementary literature	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.						
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	Introduction to Physics		
ID	PMP096	Study year	1.
Lecturer	izv. prof. dr. sc. Martina Požar	Points value (ECTS)	4.0
Associates		Class execution (number of hours in semester)	L: 45, S: 0, E: 15, P: 0
Subject status	Compulsory	Online percentage	0%
Subject description			
Subject goals	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		
Enrolment requirements	Enrollment in the 1st year of undergraduate study		
Learning outcomes	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.		
Syllabus	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) 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)
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☐ Mentoring ☐ ☐ ☐ ☐
Student obligations	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.

Monitoring student work

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

Assessment and evaluation of student work	Contribution to the final grade: 1. written exam (or two partial exams) – 50% 2. oral exam – 50%

Required literature

Title	Number of copies available	Availability on other medium
[1] D. Halliday, R. Resnick, J. Walker, Fundamentals of Physics. 9th Edition, John Wiley, New York 2011.	21	

Supplementary literature	[1] P. G. Hewitt, Conceptual Physics, 12th Edition, Pearson 2010. [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 Environmental Physics</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">10%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">Provide knowledge on:
– Solar and Earth radiation
– Atmospheric composition, structure and dynamics
– Ocean structure and dynamics
– Climate change: causes and manifestation</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">Prerequisites
– Basic physics
– Basic mathematics</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Understanding of Solar and Earth radiation budget
Knowledge of atmospheric structure and dynamics
Knowledge of ocean structure and dynamics
Understanding of natural and anthropogenic climate change</td></tr>
<tr><td>Syllabus</td><td colspan="6">1. Solar radiation and global energy budget (2 h)
2. Absorption spectra of the atmosphere (2 h)
3. Greenhouse effect (2 h)
4. Vertical profile of the atmosphere: temperature, density and air pressure (2 h)
5. Convective processes, dry and moist-adiabatic processes, formation of clouds (2 h)
6. Meridional structure of the atmosphere (2 h)
7. Global circulation of the atmosphere (2 h)
8. Ocean properties (2 h)
9. Profiles of ocean density, temperature and salinity (2 h)
10. Thermohaline circulation (2 h)
11. Wind circulation (2 h)
12. Climate of the Mediterranean region (4 h)
13. Climate change in the atmosphere and ocean: natural variability (2 h)
14. Climate change in the atmosphere and ocean: anthropogenic impact (2 h)</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">☑
Homework
☐
☐
☐</td></tr>
</table>

<table>
<tr><td>Student obligations</td><td colspan="6">Attend at least 70% of all lectures; write homework</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>Domaći rad</td><td>1.0</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 of student work</td><td colspan="6">Final grade is based on:
– Oral exam
– Homework</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">Mirko Orlić, 2022. Uvod u fizičku oceanografiju, ELEMENT, Zagreb. 335 str.</td><td>6</td><td>NO</td></tr>
<tr><td colspan="4">John Marshall, R. Alan Plumb, Atmosphere, Ocean, and Climate Dynamics: An Introductory Text, Elsevier, 319 str.</td><td>0</td><td>YES</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"></td></tr>
</table>

Subject name	Introduction to Quantum Field Theory		
ID	PMP236	Study year	2.
Lecturer	doc. dr. sc. Marko Kovač	Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 15, P: 0
Subject status	Elective	Online percentage	30%

Subject description	
Subject goals	Acquisition of basic knowledge and competences in Quantum Field Theory. Introduction to main ideas and theoretical frameworks used in Quantum Field Theory.
Enrolment requirements	Acquired learning outcomes of the following courses: Quantum Physics, Special Theory of Relativity, and Elementary Particle Physics I.
Learning outcomes	1. Understanding of quantum field theory at a level that allows applications to phenomena and processes from Solid State Physics to Elementary Particle Physics. 2. Acquiring the knowledge needed to understand advanced applications of Quantum Field Theory. 3. Acquiring knowledge for analytical setting and solving complex problems by applying advanced mathematical methods.
Syllabus	1. Boson fields - classical fields, Noether theorem, canonical field quantization, free Klein-Gordon field, particles as field excitations, antiparticles, non-relativistic quantum fields and Landau-Ginzburg theory, electromagnetic field quantization, quantum fluctuations, Casimir effect. 2. Fermion fields - Dirac equation, problems of one-particle interpretation, quantization of free Dirac field, discrete symmetries, spin-statistics theorem. 3. Fields in interaction - processes, S-matrix and shock sections, Feynman diagrams, some basic processes in quantum electrodynamics. 4. Functional methods - integrals along paths, connection with statistical mechanics, symmetries. 5. Spontaneous symmetry breaking - Goldstone bosons, Higgs mechanism. 6. Introduction to the theory of renormalization - loops and infinities, fiel
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. Solve homework assignments.

Monitoring student work					
Class attendance		Research		Practical work	
Experimental work		Paper		Homework assignment	1
Essay		Seminar paper			
Colloquiums		Oral exam	2.0		
Written exam	2.0	Project			

Assessment and evaluation of student work	Pass two midterm exams with a minimum score of 50% at each midterm or pass the final exam with a minimum score of 50%. Midterm exams and final exam consist of both oral and written parts.

Required literature	Title	Number of copies available	Availability on other medium
	M. E. Peskin, D. V. Schroeder: An Introduction to Quantum Field Theory, (Westview Press; 1995)		
	A. Zee: Quantum Field Theory in a Nutshell, (2. izdanje, Princeton University Press; 2010)		
Supplementary literature	[1] AITCHISON, I. J. (FL :). Gauge theories in particle physics : a practical introduction. Boca Raton, FL: CRC Press. [2]Slides and lecture notes.		
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">Introduction to Mathematical Logic and Set Theory</td></tr>
<tr><td>ID</td><td>PMM700</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>doc. 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)

– Propositional Logic: syntax and semantics (2)

– Normal forms (1)

– Propositional Calculus (2)

– Deductive Calculus (2)</td></tr>
</table>

	– 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 ☐ Seminars ☑ Exercises ☐ Fully online ☐ Combined online		☐ Fieldwork ☐ 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			

<table>
<tr><td>Assessment and evaluation of student work</td><td colspan="3">Two partial written exams / one final written exam and final oral exam.</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>M. Vuković, Matematička logika 1, PMF, Zagreb, 2007.</td><td></td><td></td></tr>
<tr><td>V. Matijević, Uvod u teoriju skupova, skripta, PMF, Split, 2014.</td><td></td><td></td></tr>
<tr><td>P. Papić, Uvod u teoriju skupova, HMD, Zagreb, 2000.</td><td></td><td></td></tr>
<tr><td>Supplementary literature</td><td colspan="3">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</td></tr>
<tr><td>Quality assurance</td><td colspan="3">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="3"></td></tr>
</table>

Subject name	Introduction to Fluid Mechanics		
ID	PMP261	Study year	2.
Lecturer	izv. prof. dr. sc. Bernarda Lovrinčević	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	20%
Subject description			
Subject goals	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.		
Enrolment requirements	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		
Learning outcomes	· 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		
Syllabus	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) 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)		
Teaching types	☑ Lectures ☐ Seminars ☑ Exercises	☐ Fieldwork ☐ Individual assignments ☑ Multimedia	☑ domaće zadaće ☐

	☐ Fully online ☐ Combined online		☐ Laboratory ☐ Mentoring		☐ ☐	
Student obligations	Writing reports on the conducted experiments. Attendance.					
Monitoring student work	Class attendance	1.5	Research		Practical work	
	Experimental work		Paper		Domaće zadaće	0.5
	Essay		Seminar paper			
	Colloquiums		Oral exam	2		
	Written exam	2	Project			
Assessment and evaluation of student work	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).					
Required literature	Title				Number of copies available	Availability on other medium
	Philip J. Pritchard, John W. Mitchell, Fox and McDonald's Introduction to Fluid Mechanics John Wiley & Sons, 2011.					
Supplementary literature	D. J. Acheson Elementary Fluid Dynamics Clarendon Press, 2005. Y. Nakayama & R. F. Boucher Introduction to Fluid Mechanics Butterworth, 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	Introduction to Data Analysis						
ID	PMP165	Study year	1.				
Lecturer	izv. prof. dr. sc. Žarko Kovač	Points value (ECTS)	5.0				
Associates		Class execution (number of hours in semester)	L	S	E	P	
			20	0	30	0	
Subject status	Compulsory	Online percentage	0%				
Subject description							
Subject goals	– 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						
Enrolment requirements	– basics of physics – basics of mathematics – basic programming						
Learning outcomes	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.						
Syllabus	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)						
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	1.7	Research		Practical work	1.3	

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

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 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.		
Required literature	Title	Number of copies available	Availability on other medium
	William Menke, Joshua Menke Environmental Data Analysis with MATLAB Elsevier, 2016		
Supplementary literature	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.		
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	Introduction to Superconductivity		
ID	PMP381	Study year	2.
Lecturer	prof. dr. sc. Ante Bilušić	Points value (ECTS)	3.0
Associates		Class execution (number of hours in semester)	L: 30, S: 0, E: 0, P: 0
Subject status	Elective	Online percentage	20%

Class execution (number of hours in semester)	L	S	E	P
	30	0	0	0

Subject description	
Subject goals	Theoretical understanding of superconductivity and related phenomena.
Enrolment requirements	Acquired competences: basics of thermodynamics, classical electrodynamics and solid state physics.
Learning outcomes	Understand principles of macroscopic and microscopic description of superconductivity, describe on quantitative and qualitative manner electrical, magnetic, and thermal properties of superconductors, understand applications of superconducting materials in different cases, analyse row-data of basic physical properties of superconductor (e.g., electrical resistivity, specific heat).
Syllabus	Introduction. Historical development. London model. (2 hours) Thermodynamical introduction of ferromagnetism. Landau model of ferromagnetism. Introduction to Ginzburg-Landau model. (2 hours) Ginzburg-Landau free energy. Derivation of Ginzburg-Landau equations. (4 hours) Critical field: Ginzburg-Landau and thermodynamical approaches. Ginzburg-Landau penetration depth and the coherence length. (2 hours) Critical fields within Ginzburg-Landau theory. (2 hours) Critical currents. (2 hours) Introduction to Bardeen-Cooper-Schrieffer (BCS) theory: Cooper pair formation, isotopic effect. (2 hours) Origin of attractive force between electrons: cases of free electron gas and metals with ions included. (4 hours) BCS theory at absolute zero: energy gap and ground state. (2 hours) BCS theory at T>0: energy gap, critical temperature, specific heat. (4 hours) Metal-insulator-metal, metal-insulator-superconductor and superconductor-insulator-superconductor junctions, Josephson effects. (2 hours) Introduction to high-temperature superconductors. (2 hours)
Teaching types	[x] Lectures [ ] Seminars [ ] Exercises [ ] Fully online [ ] Combined online [ ] Fieldwork [ ] Individual assignments [ ] Multimedia [ ] Laboratory [ ] Mentoring [x] Rješavanje problemskih zadataka (domaće zadaće) [ ] [ ] [ ]
Student obligations	Problems' solving during the semester. Attendance.

Monitoring student work						
	Class attendance	1	Research		Practical work	
	Experimental work		Paper		Rješavanje problemskih zadataka (domaće zadaće)	0.5
	Essay		Seminar paper			
	Colloquiums		Oral exam	1.5		

	Written exam		Project			

Assessment and evaluation of student work	Students are obliged to solve given problems during the semester. The final exam is the oral one when students have to answer questions that are defined at the very beginning of the semester. The total grade is result of both problems solving (1/3 of the grade) and oral exam (2/3 of the grade).		
Required literature	Title	Number of copies available	Availability on other medium
	James F. Annett: Superconductivity, Superfluids and Condensates, Oxford University Press, 2004.		yes
	Michael Tinkham: Introduction to Superconductivity, Dover Books on Physics, 2004.		no
	Presentation slides		da
Supplementary literature	Michel Cyrot, Davor Pavuna: Introduction to Superconductivity and High-Tc materials, World Scientific, 1992.		
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	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)	

<table>
<tr><td>Subject name</td><td colspan="6">Introduction to Artificial Intelligence</td></tr>
<tr><td>ID</td><td>PMII10</td><td>Study year</td><td colspan="4">3.</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>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">25%</td></tr>
<tr><td colspan="7">Subject description</td></tr>
<tr><td>Subject goals</td><td colspan="6">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.</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, 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.</td></tr>
<tr><td>Syllabus</td><td colspan="6">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)
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>☑ Lectures
☐ Seminars
☐ Exercises</td><td>☐ Fieldwork
☑ Individual assignments
☐ Multimedia</td><td colspan="4">☐
☐
☐</td></tr>
</table>

<table>
<tr><td></td><td colspan="6">☐ Fully online
☑ Combined online</td><td colspan="2">☑ Laboratory
☐ Mentoring</td><td>☐</td></tr>
<tr><td>Student obligations</td><td colspan="9">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 colspan="4">Practical work</td><td>1</td></tr>
<tr><td>Experimental work</td><td></td><td>Paper</td><td></td><td colspan="4"></td><td></td></tr>
<tr><td>Essay</td><td></td><td>Seminar paper</td><td></td><td colspan="4"></td><td></td></tr>
<tr><td>Colloquiums</td><td>0.5</td><td>Oral exam</td><td>0.5</td><td colspan="4"></td><td></td></tr>
<tr><td>Written exam</td><td>0.5</td><td>Project</td><td>1</td><td colspan="4"></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="9">Attendance/Participation (20%)
Midterm / Project (40%)
Final/Oral Exam (40%)</td></tr>
<tr><td rowspan="3">Required literature</td><td colspan="5">Title</td><td colspan="2">Number of copies available</td><td colspan="2">Availability on other medium</td></tr>
<tr><td colspan="5">Artificial Intelligence: A Modern Approach. Stuart Russell and Peter Norvig Prentice Hall, 2009 ISBN:0136042597 9780136042594</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="5">Lecture notes: Uvod u umjetnu inteligenciju, Saša Mladenović, Goran Zaharija</td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>Supplementary literature</td><td colspan="9">Online Student material, including solutions to selected problems and additional reading</td></tr>
<tr><td>Quality assurance</td><td colspan="9">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="9"></td></tr>
</table>

Subject name	Waves and Optics		
ID	PMP006	Study year	3.
Lecturer	izv. prof. 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	Elective	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	☐ Fieldwork ☑ Individual assignments ☐ Multimedia ☐ Laboratory	☐ ☐ ☐ ☐

	☐ Combined online		☐ 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)	

Subject name	Probability I						
ID	PMM228	Study year	1.				
Lecturer	doc. dr. sc. Vesna Gotovac Đogaš	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	30%				
Subject description							
Subject goals	Course objective is stating and proving main results from classical probability theory using measure theory.						
Enrolment requirements	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.						
Learning outcomes	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						
Syllabus	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) 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)						

<table>
<tr><td>Subject name</td><td colspan="6">ASSESSMENT IN EDUCATION</td></tr>
<tr><td>ID</td><td>PMM809</td><td>Study year</td><td colspan="4">2.</td></tr>
<tr><td>Lecturer</td><td>Željka Zorić, v. pred.</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>30</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">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</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6">No prerequisites for the course.</td></tr>
<tr><td>Learning outcomes</td><td colspan="6">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</td></tr>
<tr><td>Syllabus</td><td colspan="6">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)</td></tr>
</table>

	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 of student work	Students attending the course regularly (over 90% of the class), who received a positive evaluation for writing and 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">Spices and Aromatic Herbs</td></tr>
<tr><td>ID</td><td>PMBN29</td><td>Study year</td><td colspan="4">3.</td></tr>
<tr><td>Lecturer</td><td>prof. dr. sc. Valerija Dunkić</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">The objective of this course is to introduce the different families of aromatic and spice plants, their main extracts and their applications in the cosmetic and pharmaceutical industries.</td></tr>
<tr><td>Enrolment requirements</td><td colspan="6"></td></tr>
<tr><td>Learning outcomes</td><td colspan="6">Students will be able to:
1. Identify the most common edible wild plants
2. Distinguish which species are suitable for human consumption
3. Know which species are used as spices and additives
4. Know the role of pharmaceutical herbal preparations in the treatment of some diseases
5. Be familiar with the isolation of important phytochemicals</td></tr>
<tr><td>Syllabus</td><td colspan="6">Lectures
1. Introductory lecture – Herbs and spices
2. Historical use of medicinal herbs
3. Production of extracts from herbs and spices
4. Bioactive substances of herbs and spices
5. Requirements and factors for organic farming
6. Extraction techniques
7. Flora Croatica Database (FCD)
8. Families Lamiaceae, Apiaceae, Asteraceae
9. Use of herbs and spices
Seminars
Spice aromatic plants – collection, identification and drying plant material
Spice and aromatic species of the Lamiaceae family
Spice and aromatic plants of the Asteraceae family
Spice and aromatic plants of the Apiaceae family
Extraction techniques – distillation
Extraction techniques – cold pressing and solvent extraction
Production of natural cosmetics</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>
</table>

Student obligations	Class attendance: 75% of lectures and 100% of seminars, completed seminar and written exam.					
Monitoring student work	Class attendance	0.5	Research		Practical work	
	Experimental work	0	Paper			
	Essay		Seminar paper	1		
	Colloquiums		Oral exam			
	Written exam	0.5	Project			
Assessment and evaluation of student work	Written exam 40% Held seminar presentation 40% Attendance 20%					
Required literature	Title	Number of copies available	Availability on other medium			
	Jekka McVicar-Grow Herbs - DK Publishing 2010		pdf			
	K.V. Peter- Handbook of herbs and spices		pdf			
Supplementary literature	Ljubiša Grlić Enciklopedija samoniklog jestivog bilja, August Cesarec, Zagreb					
Quality assurance	The quality of teaching is monitored by obtaining feedback from students in the form of consultations, discussions and questions during lessons. At the end of the semester, courses and teachers are evaluated through anonymous student surveys. Student performance on the exam is analyzed and used to improve quality in the coming academic year.					
Other (in the opinion of the proponent)						

Subject name	Undergraduate Thesis		
ID	PMPBSC	Study year	3.
Lecturer		Points value (ECTS)	5.0
Associates		Class execution (number of hours in semester)	L: 0 S: 15 E: 0 P: 0
Subject status	Compulsory	Online percentage	0%

Subject description	
Subject goals	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.
Enrolment requirements	Compulsory subject of the last year of study. The defense is approached when all other subjects have been passed.
Learning outcomes	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.
Syllabus	Under the guidance of a mentor, students carry out all activities themselves, from designing the work to preparing the written work and presentation.
Teaching types	☐ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring
Student obligations	Independent preparation of the work, implementation and presentation.

Monitoring student work						
	Class attendance		Research		Practical work	
	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)			

Subject name	Undergraduate Thesis		
ID	PMPBSC	Study year	3.
Lecturer		Points value (ECTS)	3.0
Associates		Class execution (number of hours in semester)	L: 0, S: 15, E: 0, P: 0
Subject status	Elective	Online percentage	0%

Subject description

Subject goals	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.
Enrolment requirements	Compulsory subject of the last year of study. The defense is approached when all other subjects have been passed.
Learning outcomes	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.
Syllabus	Under the guidance of a mentor, students carry out all activities themselves, from designing the work to preparing the written work and presentation.
Teaching types	☐ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online ☐ Fieldwork ☐ Individual assignments ☐ Multimedia ☐ Laboratory ☑ Mentoring
Student obligations	Independent preparation of the work, implementation and presentation.

Monitoring student work

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

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)	

Subject name	Scientific Communication		
ID	PMP105	Study year	2.
Lecturer	izv. prof. dr. sc. Bernarda Lovrinčević izv. prof. dr. sc. Martina Požar	Points value (ECTS)	2.0
Associates		Class execution (number of hours in semester)	L: 20 S: 10 E: 0 P: 0
Subject status	Elective	Online percentage	50%
Subject description			
Subject goals	– developing the ability to communicate with the general population, especially young people, on scientific topics – acquiring the skills needed to popularize science – introduction to the process of publishing a scientific paper and the structure of the Croatian scientific community – presentation of scientific content in written and audiovisual form in a way that is appropriate for non-scientific audiences, but also for other scientists		
Enrolment requirements			
Learning outcomes	1. present the scientific problem, its analysis and results in the form of a text intended for non-scientific audiences, 2. recognize the most important results and conclusions of the scientific text in order for the wider (non-scientific) audience to get the correct information, avoiding the use of too professional language and expressions, 3. present a scientific topic in audiovisual form (short film, interview, etc.) with the aim of popularizing science, 4. present the scientific problem, its analysis and results in discussion with fellow scientists.		
Syllabus	1. Introduction to scientific communication. Essay writing. 2. How to successfully communicate about science with a non-scientific audience. 3. How to write a scientific paper. 4. The process of publishing a scientific paper. Scientific bases. 5. How to successfully hold a scientific presentation at a conference. 6. How to successfully present your work in the form of a poster. 7. How to successfully present your work in the form of a video (documentary, interview). 8. How to present your work through a website. 9. Classification of scientists in Croatia (scientific conditions). 10. Science journalism: challenges of the digital age. 11. The role of scientists in the public. How does one become a science popularizer? 12. Scientists as Popular Persons: Advantages and Disadvantages. 13. Popular science books: from public education to science bestsellers. 14. Science and technology in film art. 15. Presentation of student homeworks and projects. 2S		
Teaching types	☑ Lectures ☑ Seminars ☐ Exercises ☐ Fully online ☐ Combined online	☐ Fieldwork ☑ Individual assignments ☑ Multimedia ☐ Laboratory ☐ Mentoring	☐ ☐ ☐ ☐

<table>
<tr><td>Student obligations</td><td colspan="6">1. The student is required to attend lectures and seminars, at least 70% of lectures and 80% of seminars.
2. The student is required to make a project in the form of a video aimed at promoting science.
3. The student is required to write homework.</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>Homework assignments</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></td><td></td><td></td></tr>
<tr><td>Written exam</td><td></td><td>Project</td><td>0.5</td><td></td><td></td></tr>
<tr><td>Assessment and evaluation of student work</td><td colspan="6">1. Homework – 30% of the grade.
2. Project – 70% of the 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">D. Meredith, Explaining Research: How to Reach Key Audiences to Advance Your Work (2010, Oxford University Press, USA)</td><td></td><td>web</td></tr>
<tr><td colspan="4">Routledge Handbook of Public Communication of Science and Technology (2014, Ed. M. Bucchi, B. Trench, 2nd edition, Routledge, London).</td><td></td><td>web</td></tr>
<tr><td>Supplementary literature</td><td colspan="6"></td></tr>
<tr><td>Quality assurance</td><td colspan="6">1.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.
2. Talking to students and monitoring their homework activities.</td></tr>
<tr><td>Other (in the opinion of the proponent)</td><td colspan="6"></td></tr>
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