<table>
<tr><td>NAME OF THE COURSE</td><td colspan="6">Plasma Physics and Fusion Technology</td></tr>
<tr><td>Code</td><td>PMP273</td><td>Year of study</td><td colspan="4">GU-2</td></tr>
<tr><td>Course teacher</td><td>Dragan Poljak, PhD, Professor</td><td>Credits (ECTS)</td><td colspan="4">6,0</td></tr>
<tr><td rowspan="2">Associate teachers</td><td rowspan="2">Dragan Poljak, PhD, Professor</td><td rowspan="2">Type of instruction (number of hours)</td><td>L</td><td>S</td><td>E</td><td>F</td></tr>
<tr><td>45</td><td></td><td>30</td><td></td></tr>
<tr><td>Status of the course</td><td>Elective</td><td>Percentage of application of e-learning</td><td colspan="4"></td></tr>
<tr><td colspan="7">COURSE DESCRIPTION</td></tr>
<tr><td>Course objectives</td><td colspan="6">Introduction to plasma physics and fusion technology aspects.</td></tr>
<tr><td>Course enrolment requirements and entry competences required for the course</td><td colspan="6">Mathematics (Differential and integral calculus, differential equations), General physics (classical electromagnetics, fluid mechanics, thermodynamics).</td></tr>
<tr><td>Learning outcomes expected at the level of the course (4 to 10 learning outcomes)</td><td colspan="6">1. Fundamental knowledge of plasma physics
2. Basic notions in fusion technology
3. Magnetohydrodynamics equations
4. Numerical methods for solving magnetohydrodynamics equations</td></tr>
<tr><td>Course content broken down in detail by weekly class schedule (syllabus)</td><td colspan="6">Fundamentals of plasma physics. Microscopic and macroscopic definition of plasma, Themonuclear fusion and plasma confinement. (3h L+ 2h E)
Mass conservation law and continuity equation (3h L+ 2h E)
Equation of motions. Energy flow (3h L+ 2h E)
Fundamental laws in electromagnetics, Basic concepts of electromagnetic field, Maxwell equations, Conservation law in electromagnetic field, (3h L+ 2h E)
Magnetohydrodynamics fundamentals, Magnetohydrodynamics (MHD) equations, induction equation, motion equation, energy equation (3h L+ 2h E)
Equilibrium in Magnetohydrodynamics. Simple configurations of MHD equilibrium; cylindrical geometry, toroidal geometry equilibrium, Grad-Shafranov equation. (3h L+ 2h E)
Current diffusion equation. Transport equations (3h L+ 2h E)
Analysis methods for the solution of MHD equations (3h L+ 2h E)
Numerical methods for the solution of MHD equations (3h L+ 2h E)
Application of finite difference method (3h L+ 2h E)
Application of finite element method (3h L+ 2h E)
Calculus of variations and ideal energy principle in MHD (3h L+ 2h E)
Application of toroidal plasma , tokamak, nuclear reactor, controlled thermonuclear fusion (3h L+ 2h E)
ITER and DEMO research (3h L+ 2h E)
List of exercises
Single particle modeling of plasma systems
Analytical solution of plasma systems
Analytical solution of motion equations
Analytical solution of linear cylindrical configurations
Analytical solution of Grad Shafranov equations
Numjerical solution of Grad Shafranov equation via finite difference method
Numjerical solution of Grad Shafranov equation via finite element method
Analytical solution of diffusion equation
Numerical solution of diffusion equation via finite difference method
Numerical solution of diffusion equation via finite element method
Analytical and numerical modeling of transport equations</td></tr>
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<tr><td>Format of instruction</td><td>☒ lectures
☐ seminars and workshops
☒ exercises
☐ on line in entirety
☐ partial e-learning
☐ field work</td><td>☐ independent assignments
☐ multimedia
☒ laboratory
☐ work with mentor
☐ homework assignments</td></tr>
<tr><td>Student responsibilities</td><td colspan="2">The presence on lectures in the amount of at least 70 % of the times scheduled. Performed all required laboratory exercises.</td></tr>
<tr><td>Screening student work (name the proportion of ECTS credits for each activity so that the total number of ECTS credits is equal to the ECTS value of the course)</td><td colspan="2">
<table>
<tr><th>Name</th><th>Ects</th><th>Name</th><th>Ects</th><th>Name</th><th>Ects</th></tr>
<tr><td>Class attendance</td><td>2</td><td>Research</td><td></td><td>Experimental work</td><td></td></tr>
<tr><td>Oral exam</td><td></td><td>Report</td><td></td><td>Homework assignments</td><td></td></tr>
<tr><td>Seminar essay</td><td></td><td>Essay</td><td></td><td></td><td></td></tr>
<tr><td>Tests</td><td>2</td><td>Practical training</td><td></td><td></td><td></td></tr>
<tr><td>Written exam</td><td>2</td><td>Project</td><td></td><td></td><td></td></tr>
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<tr><td>Grading and evaluating student work in class and at the final exam</td><td colspan="2">There are two midterms and final exams. The first midterm exam is after 7 weeks of lecturing and the second one is after the next 6 weeks. Each midterm test (120 min in duration) consists of 3 questions (each containing theoretical part and short numerical problem) and 2 longer numerical problems. The requirement for passing grade is the positive assessment of laboratory exercises and 50 % points on each midterm. Grade (in percentage) is formed according to the formula:
Grade(%) = 0,5 (M1 + M2)
where M1 and M2 are the midterm test results, and is determined through following percentage score:
Percentage score: Grade:
From 50% to 62% sufficient (2)
From 63% to 75% good (3)
From 76% to 88% very good (4)
From 89% to 100% excellent (5)
Students who do not pass midterm exams are obliged to pass final test (150 min in duration) in winter/fall examination period. Final test consists of 4 questions (each containing theoretical part and short numerical problem) and 2 longer numerical problems. The requirement for passing grade is 50 % points. Final grade is formed according to the described procedure.The midterm and final exams are carried out as written tests.</td></tr>
<tr><td>Required literature (available in the library and via other media)</td><td colspan="2">
<table>
<tr><th>Title</th><th>Number of copies in the library</th><th>Availability via other media</th></tr>
<tr><td>[1] D. D. Schnack: Lectures in Magnetohydrodynamics, Springer-Verlag, Berlin 2009.</td><td>0</td><td></td></tr>
<tr><td>[2] H. Goedbloed, S. Poedts, Principles of Magnetohydrodynamics, Cambridge University Press, New York, 2004.</td><td>0</td><td></td></tr>
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	[3] H. Goedbloed, S. Poedts, Advanced Magnetohydrodynamics, Cambridge University Press, New York, 2010.	0	
	[4] D. Poljak, Teorija elektromagnetskih polja s primjenama u inženjerstvu, Šk. Knjiga Zagreb, 2014.	0	
Optional literature (at the time of submission of study programme proposal)	[1] D. Poljak, Advanced Modeling in Computational Electromagnetic Compatibility, Wiley, New York, 2007.		
Quality assurance methods that ensure the acquisition of exit competences	Evaluation of results in accordance with the above learning outcomes Feedback from students via surveys Self-evaluation of teachers Institutional and non-institutional evaluations		
Other (as the proposer wishes to add)			