NAME OF THE COURSE	Introduction to Superconductivity						
Code	PMP381	Year of study	2nd year of master study				
Course teacher	Ante Bilušić	Credits (ECTS)	3.0				
Associate teachers	---	Type of instruction (number of hours)	L	S	E	F	
			30				
Status of the course	Elective course	Percentage of application of e-learning	20%				

COURSE DESCRIPTION

Course objectives	Theoretical understanding of superconductivity and related phenomena.
Course enrolment requirements and entry competences required for the course	Acquired competences: basics of thermodynamics, classical electrodynamics and solid state physics.
Learning outcomes expected at the level of the course (4 to 10 learning outcomes)	By the end of the course, students are expected to: • **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).
Course content broken down in detail by weekly class schedule (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)

Format of instruction	☒ lectures ☐ seminars and workshops ☐ exercises ☐ *on line* in entirety ☐ partial e-learning ☐ field work	☐ independent assignments ☐ multimedia ☐ laboratory ☐ work with mentor ☒ problems solving (homework)
Student responsibilities		

Screening student work *(name the proportion of ECTS credits for each activity so that the total number of ECTS credits is*						
	Class attendance	1.0	Research		Practical training	
	Experimental work		Report		Problems solving (homework)	0.5
	Essay		Seminar essay		(Other)	
	Tests		Oral exam	1.5	(Other)	

equal to the ECTS value of the course)	Written exam		Project		(Other)	

Grading and evaluating student work in class and at the final exam	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).

	Title	Number of copies in the library	Availability via other media
Required literature (available in the library and via other media)	James F. Annett: *Superconductivity, Superfluids and Condensates*, Oxford University Press, 2004.	1	no
	Michael Tinkham: *Introduction to Superconductivity*, Dover Books on Physics, 2004.	1	no
	Presentation slides	0	yes

Optional literature (at the time of submission of study programme proposal)	Michel Cyrot, Davor Pavuna: *Introduction to Superconductivity and High-Tc materials*, World Scientific, 1992.
Quality assurance methods that ensure the acquisition of exit competences	Statistics of students' results and students' evaluation via anonymous questionnaires at the end of the course. The survey is conducted according to the rules of the University of Split.
Other (as the proposer wishes to add)	