Description of an Individual Course Unit

Study program	All, except Chemistry		
Module			
Type and level of studies	PhD studies		
Course title	Physical Metallurgy		
Professor (for lectures)	Nenad Radovic		
Professor/assistant (for practice)			
Professor/assistant (for LAB)			
Number of ECTS	5	**Type of the course (mandatory/elective)**	elective
Prerequisit	-		
Objective of the course	Students will broaden their knowledge on changes of microstructure during phase transformations and thermomechanical processing and its influence on mechanical properties, which is basis for understanding the relationship between chemical composition, thermomechanical processing, structure and properties in metallic materials.		
Learning outcomes of the course	New knowledge on mechanisms that lead to changes in microstructure and determines final properties. This subject is fundamental knowledge for all metal forming and thermomechanical processes technolgies. ;		
Course Contents			
Theoretical contents	Principles of crystallography. Bravais laattice, Millers indices. Driving force for phase transformations. Transformations in liquid and solid state. Homogenous and heterogenous transformations. Diffusional and displacive mechanisms na d related kinetics. Phase diagrams: eqilibrium and non-equilibrium (TTT and CCT). Influence of cooling rate on mechanism and kinetics. Defects in crystal lattice: point, line, plane defects. Dislocation theory. Types of dislocations, geometry, Burgers vector, Stresses and energy. Dislocation sources, movement of dislocations, Unit and partial deislocations, Plastic deformation, mechanisms and geometry od slip and twinning. Stress-strain curves, plastic instanbility, strain rate sensitivity. Strengthening mechanisms. dislocation and grain refinement strengthening. Hall-Petch equation. Solid solution and particle strengthening. Recovery, recrystallization and grain growth. Kinetics of recrystallization. Grain growth inhibitors. Abnormal growth. Texture of deformed and recrystallized materials.		
Practical part (practices, LAB, study research work)	Problem solving related to crystallolgraphy and deformation behaviour.		
Literature			
1	Ђ.Дробњак, Физичка Металургија – Физика чврстоће и пластичности, ТМФ, Београд (1986)		
2	Ђ.Дробњак, Скрипте, ТМФ Београд 1993		
3	R.W.Cahn, P.Haasen, Physical Metallurgy, Elsevier 1996		
4	W.F.Hosford, Physical Metallurgy, CRC Press 2010		
5	D.Porter, K.Easterling, "Phase transformations in metals and alloys, 2nd ed., Butterworth-Heinemann, 1996.		

Lessons per week				
Lectures	**Practices**	**LAB**	**Study research work**	**Other activities**
1			1	

Teaching Methods	Lectures, problems and laboratory

Grading methods (max. number of points is 100)			
Pre-exam assesments	**points**	**Final examination**	**points**
activity during lectures		**written exam**	
practical assesments		**oral exam**	60
mid-term exams	40		
seminars			