No. 36

Attachment No.3		**Course syllabus for First cycle studies**			
1.	**Course title**	**Non-ferrous metallurgy**			
2.	**Code**	MDE5M3			
3.	**Study Program**	Metallurgical digital engineering			
4.	**Study program organizer (unit,institute, department, division)**	Faculty of Technology and Metallurgy, University "Ss. Cyril and Methodius" in Skopje			
5.	**Degree (first, second, third cycle)**	First cycle			
6.	**Academic year / semester**	Third year, V sem.	7.	**Number of ECTS**	5
8.	**Instructors**	PhD Ana Tomova, Assoc. prof			
9.	**Prerequisites for courseenrollment**	Preparation of mineral raw materials			
10.	**Objectives of the course syllabus (competencies):** Acquiring knowledge about raw materials, properties, technological processes for obtaining non-ferrous metals and their application.				
11.	**Content of the course:** 1. Copper metallurgy. Introduction. Properties. Production Methods. Pyrometallurgical Production. Concentration, roasting, smelting of copper concentrate in a flash furnace, Smelting of copper ores in a shaft furnace, Converting, Refining – fire refining and electrorefining. Modern Copper Production Methods. Flash smelting and continuous processes. Extraction of precious metals. Hydrometallurgical Production. Leaching of low-grade ores, Leaching methods and equipment. Applications. 2. Lead Metallurgy. Introduction. Properties. Production Methods. Pyrometallurgical Production. Concentration (flotation), roasting, smelting, refining – fire refining and electrorefining. Modern Lead Production Methods. Thermodynamic analysis of direct smelting of lead concentrates, Mechanism of direct smelting of lead concentrates, KIVCET process, Ausmelt/ISA process, Boliden TBRC process, QSL process, Other direct smelting processes. Production from Secondary Raw Materials, With and without pretreatment. Applications. 3. Zinc Metallurgy. Introduction. Properties. Pyrometallurgical Production. Roasting, reduction, distillation and condensation, refining. Hydrometallurgical Production. Applications. 4. Nickel Metallurgy. Introduction. Properties. Pyrometallurgical Production. Pyrometallurgical extraction from sulfide and oxide ores, Production of ferronickel from oxide ores. Hydrometallurgical Production. Pressure leaching, atmospheric leaching, aqueous leaching, and other leaching methods. Applications. 5. Cobalt Metallurgy. Introduction. Properties. Production Methods. Extraction from copper ores, Extraction from nickel laterite ores, Extraction from nickel sulfide ores, Extraction from secondary raw materials. Applications. 6. Tin Metallurgy. Introduction. Properties. Pyrometallurgical Production. Concentrate preparation, reduction, slag processing, refining – fire refining and electrorefining. Applications. 7. Aluminum Metallurgy. Introduction. Properties. Aluminum Production. Bayer process for alumina production, Hall-Héroult process, Refining.Applications. 8. Magnesium Metallurgy. Introduction. Properties. Production Methods. Pyrometallurgical Production. Thermal reduction of MgO, Carbothermic reduction, Aluminothermic reduction, Silicothermic reduction. Electrometallurgical Production. Dow process, Chlorination of MgO, Electrolysis, Refining of electrolytic magnesium. Applications.				

12.	**Study methods:** Lectures and exercises, consultations, project (homework, seminar) assignments, home study (exam preparation)				
13.	**Total available time**		210		
14.	**Allocation of available time**				
15.	**Teaching activities**	15.1.	Lectures	45	
		15.2.	Exercises (laboratory, computational), teamwork	45	
		15.3	Industrial practice	0	
16.	**Other types of activities**	16.1.	Project assignments	20	
		16.2.	Independent assignments	20	
		16.3.	Home study	80	
17.	**Grading system**				
	17.1.	Tests: pts		80	
	17.2.	Seminar work/project, written and oral presentation: pts		10	
	17.3.	Final exam: pts		10	
18.	**Grading criteria (points/grade)**	Up to 61 points		5 (five) (F)	
		From 61 to 69 points		6 (six) (E)	
		From 70 to 79 points		7 (seven) (D)	
		from 80 to 89 points		8 (eight) (S)	
		From 90 to 95 points		9 (nine) (B)	
		from 95 to 100 points		10 (ten) (A)	
19.	**Prerequisites for taking the final exam**	Minimum 11 pts from activities 17.1 and 17.2			
20.	**Language in which lectures are conducted**	English			
21.	**Method for monitoring the quality of lectures**	Anonymous student survey			
22.	**LITERATURE**				

22.1. Compulsory literature

No.	Author	Title	Publisher	Year
1.	Ana Tomova	Non-ferrous metallurgy	Ss Cyril and Methodius University in Skopje	2024
2.	N. Nacevski, N. Filipovska	Non-ferrous metallurgy (problems and solutions)	Faculty of Technology and Metallurgy, Skopje	1988

22.2. Additional literature

No.	Author	Title	Publisher	Year
1.	N. Nacevski	Non-ferrous metallurgy	Faculty of Technology and Metallurgy, Skopje	1993