Course Name								
Chemical Metallurgy								
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Course Implementation, Hours/Week**				
				Theoretical		**Tutorial**		**Laboratory**
MET 321	5	4	5	4		0		-
Department/Program	Metallurgical and Materials Engineering							
Course Type	Required			**Course Language**		Turkish		
Course Prerequisites	Met 231 min FF, Met 222 min FF							
Course Category by Content, %	**Basic Sciences**		**Engineering Science**		**Engineering Design**		**General Education**	
	-		70 %		30 %		-	
Course Description	Raw materials (ore, concentrate and recycled materials). Pyrometallurgy (oxide, chloride, sulphide and carbide formation using Ellingham diagrams, vapor pressure-temperature relation of metal compounds, roasting, evaporation using P-T diagrams, calcination, matte formation/smelting, slag formation/smelting, reduction, reduction smelting processes, refining). Hydrometallurgy (leaching, solution processing, EMF series, solvent extraction, Mc-Cabe Thiele diagrams). Electrometallurgy (cementation, electrowinning, electrorefining, fused salt electrolysis, Polarization diagrams). General knowledge of reaction kintetics.							
Course Objectives	1. To provide fundamental concepts utilized in Metallurgical and Materials Engineering, along with examples from the real-life applications, indicating that these concepts are not just “notions” but must be recognized as a whole. 2. To teach all the methods and processes employed on the route “from ore to metal”, in a manner of providing an infrastructure for other courses.							
Course Learning Outcomes	Students who pass the course will be able to: I. Identify metallurgical raw materials, pretreatment operations, ore processing methods, surface enlargement and reduction operations and separation techniques. II. Learn the general characteristics of pyrometallurgical processes; chlorination, sulfatizing, oxidizing, sinter roasting, alkaline roasting, selective vaporization, selective decomposition, calcination, matte forming/smelting, slag forming/smelting, reduction and reduction with non-metallic compounds. III. Understand reducing melting operations, reducing vaporization operations, reduction in molten state, metallothermic reduction (aluminothermy, silicothermy, magnesiothermy). IV. Know pyrometallurgical raffination operations, fire raffination of copper, segregation and drossing, raffination in gaseous state, zone raffination. V. Comprehend the general characteristics of hydrometallurgy**;** dissolution operations, in-situ leach, heap leach, percolation leach, pressure leach, solution processing, crystallization. VI. Learn precipitation with chemical additives, precipitation with gases, selective precipitation under pressure, total precipitation under pressure, solvent Extraction, McCabe-Thiele diagrams and applications, reaction kinetics. VII. Identify the general characteristics of electrometallurgy**;** cementation, electrowinning, electrorefining, fused salt electrolysis, polarization diagrams. VIII. Learn the flow diagram for production and refining of a certain metal related to its physicochemical characteristics.							
Textbook	F.Habashi, Handbook of Extractive Metallurgy, Wiley-Vch, 1997. İ.Duman, Kimyasal Metalurji Ders Sunuları, 2004.							
Other References	P.C. Hayes, Process Selection in Extractive Metallurgy, Hayes Pub. Co., 1985. T. Rosenqvist, Principles of Extractive Metallurgy, McGraw-Hill, 1983. B.A. Wills, Mineral Processing Technology, Pergamon Press, 1989. J.J. Moore, Chemical Metallurgy, Butterworths, 1981. F.Y. Bor, Ekstraktif Metalurji Prensipleri, 1 ve 2 cilt, İTÜ Matbaası, 1989. F.Pawlek, Metallhüttenkunde, Walter de Gruyter, 1983.							
Homework & Projects	Each workteam (consisting of 5-6 students) will receive one homework.							
Laboratory Work	-							
Computer Use	-							
Other Activities	-							
Assessment Criteria	**Activities**			**Quantity**		**Effects on Grading, %**		
	Midterm Exams			MIN 1		20 %		
	Quizzes			MIN 2		10 %		
	Homework			MIN 1		10 %		
	Projects			-		-		
	Term Paper/Project			-		-		
	Laboratory Work			-		-		
	Other Activities			-		-		
	Final Exam			1		60 %		

COURSE PLAN

Weeks	Topics	Course Outcomes
1	Raw materials (ore, concentrate, scrap) and pretreatment methods	I
2	Separation Techniques	I
3	Pyrometallurgical processes	II
4	Reduction Methods	III
5	Reduction Methods	III
6	Raffination Operations	IV
7	Raffination Operations	IV
8	Raffination Operations	IV
9	Hydrometallurgical Processes	V
10	Precipitation Operations	VI
11	The principles of electrometallurgy	VII
12	Electrometallurgical Applications	VII
13	The Presentation of Teamworks	
14	Flow Diagrams	VIII

Relationship between the Course and Metallurgical and Materials Engineering Curriculum

	Program Outcomes	Level of Contribution		
		1	2	3
1	Ability to apply the knowledge of mathematics, science and engineering principles to solve problems in metallurgical and materials engineering (ABET:a)			x
2	Ability to characterize materials using standard and/or self designed experimental methods and to evaluate the results (ABET:b)			
3	Ability to design a system or a process, taking into consideration of the desired specifications, quality, ethics and environment. (ABET:c)	x		
4	Ability to communicate both orally and in the written form and to take part in, and provide leadership of the teams in the elucidation of engineering problems; (ABET:d, g)		x	
5	Ability to define, formulate and solve engineering problems in the development, production, processing, protection and usage of engineering materials. (ABET:e)			x
6	An understanding of professional and ethical responsibilities(ABET:f)	x		
7	An understanding of current/contemporary issues and impact of engineering solutions in broad cultural, national and global levels;. (ABET:h, j)		x	
8	A comprehension of the nature of engineering progress closely linked with the development of new materials and production processes. An ability to engage in life-long learning and a recognition of its necessity (ABET:i)		x	
9	Ability to use essential tools and techniques of modern engineering in the development, production, processing, protecting and surface treatment of the existing and new engineering materials. (ABET:k)			x

1: Little, 2. Partial, 3. Full

Course relationships with major elements of the field and material classes

		Level of Contribution		
		1	2	3
MAJOR ELEMENT OF THE FIELDS	STRUCTURE		x	
	PROPERTIES		x	
	DESIGN EXPERIMENT/ANALYSE DATA	x		
	PROCESSING			x
	COST/PERFORMANCE		x	
	QUALITY/ENVIRONMENT		x	
	DESIGN PROCESS OR PRODUCT			x
MATERIAL CLASSES	METAL			x
	CERAMICS			x
	POLYMERS			
	COMPOSITES			

1: Little, 2. Partial, 3. Full

Prepared by	Date	**Signature**
Prof. Dr. İsmail DUMAN	27.07.2009	