PROCESS METALLURGY						
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Course Implementation, Hours/Week**		
				Theoretical	**Tutorial**	**Laboratory**
MET374E	6	2	4	2	-	-

Department/Program	Metallurgical and Materials Engineering		
Course Type	Elective	**Course language**	English
Course Prerequisites	none		

Course Category by Content, %	**Basic Sciences**	**Engineering Science**	**Engineering Design**	**General Education**
	-	20 %	80 %	-

Course description	This course is intended to serve as a comprehensive course in process engineering metallurgy for an upper undergraduate in the metallurgical engineering & materials science curriculum. Engineering aspects of mineral processing, including unit operations and flow sheets. Science and technology of metal extraction with applications to specific ferrous and non-ferrous metals. The course includes methods for reactors used in iron and steelmaking, non-ferrous metallurgy, handling and use of metallurgical by-products, project task, and scaling-up of some metallurgical reactors and processes.
Course objectives	The aim of this course is to develop an understanding of principles of metallurgical processes, reactor design, metallurgical reactions, and development of metallurgical processes. Many of the unique features of metallurgical systems have been described in sufficient detail and numerous illustrative examples have been included so that it should also be useful for future metallurgical engineers working in the development period of new processes and/or in the continuation of the current processes.
Course learning outcomes	The students who successfully pass this course gain knowledge, skill and competency in the following subjects; I. Describe and explain processes and reactors for extraction and manufacturing of metals and alloys II. Knowledge of structure and properties of metallurgical matters III. Basic transport phenomena approaches in the applications of metallurgical processing IV. Estimation of chemical and electrochemical reaction rates based on kinetic perspective V. Important considerations in reactor design and scaling-up studies VI. Environmental concerns both in current and future metallurgical processes
Textbook	• Engineering in Process Metallurgy, Guthrie R.I.L., Carreon Press Oxford, 1993. • Treatise on Process Metallurgy, Vol.1,2,3, Editor-in-Chief: Seetharaman S., Elsevier, 2014.
Other references	• Handbook of Extractive Metallurgy, Habashi F., Wiley-VCH, 1997. • Transport Phenomena in Materials Processing, Poirier D.R., Geiger G.H., The Minerals, Metals & Materials Society, 2016. • Transport Phenomena in Metallurgy, Geiger G.H., Poirier D.R., Addison Wesley Pub. Co., 1973. • Engineering Data on Mixing, Mezaki R., Mochizuki M., Ogawa K.; Elsevier Science, 1999. • Perry's Chemical Engineers' Handbook, Tilton J., 8th Ed., McGraw Hill, 2008.
Homework & projects	One group project
Laboratory work	None
Computer use	None
Other activities	None

Assessment criteria	**Activities**	**Quantity**	**Effects on grading, %**
	Midterm exams	**1**	**30 %**
	Quizzes	**-**	**-**
	Homework	**-**	**-**
	Projects	**-**	**-**
	Term Paper/Project	**1**	**30%**
	Laboratory Work	**-**	**-**
	Other Activities	**-**	**-**
	Final exam	**1**	**40 %**

COURSE PLAN

Weeks	Topics	Course outcomes
1	Process Metallurgy – An Argosy Through Time	1-6
2	Introduction to Metallurgical Processing	1-6
3	Descriptions of high-temperature metallurgical processes, their example applications and principles	1-6
4	Classification of Metallurgical Reactors	1-4
5	Classification of Metallurgical Reactors and example applications	1-6
6	Importance of Transport Phenomena in Metallurgical Processing	1-5
7	Furnace design examples based on thermal conductivity calculations	1-5
8	Reactor design examples considering properties of fluid flows	1-5
9	Chemical and Electrochemical Reaction Kinetics	1, 4
10	Non-ferrous process principles and product technologies (I): Aluminium production, its principles	1-6
11	Non-ferrous process principles and product technologies: Titanium production technologies, their principles and alternative new approaches	1-6
12	Single crystal manufacturing technologies and examples: Silicon and Germanium	1-6
13	Process Concept for Scaling-Up and Plant Studies	1-6
14	Environmental aspects and the future of process Metallurgy	1, 6

Relationship between the Course and Metallurgical and Materials Engineering Curriculum

	Program Outcomes	Level of Contribution		
		1	2	3
1	An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics		X	
2	An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors		X	
3	An ability to communicate effectively with a range of audiences			
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts			X
5	An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives		X	
6	An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions			X
7	An ability to acquire and apply new knowledge as needed, using appropriate learning strategies			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			
	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	X		
	COMPOSITES		X	

1: Little, 2: Partial, 3: Full

Prepared by	Date	Signature
Assoc. Prof. Dr. Güldem KARTAL ŞİRELİ	September, 2021	