Course Name						
MASS AND ENERGY BALANCE						
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Course Implementation, Hours/Week**		
				Theoretical	**Tutorial**	**Laboratory**
MET 248E	4	2	4	2	-	-

Department/Program	Metallurgical and Materials Engineering		
Course Type	Required	**Course language**	English
Course Prerequisites	MET 215E		

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

Course description	Dimensions, System of Units and Conversion Factors; molar units, density, concentration. Stoichiometry; atomic and molecular mass, chemical equations, excess and limiting reactants, oxidation and reduction. Sampling and Measurements Procedures; description of error, precision, accuracy and repeatability, measurement of weight, pressure, flow rate, etc. Material Balances; conservation of mass, mass balance analyses, systems with or without chemical reaction, recycling & by-pass circuits, Energy Balances; heat balance, electrometallurgical and electrothermic energy balances, staged heat balances, simultaneous material and energy balances, process analysis. Examples of materials and energy balances for metallurgical reactors.
Course Objectives	This course covers the fundamental concepts in the field of Metallurgical Engineering, along with numerical examples from the existing industrial applications. Almost all processes, utilized in metal production Technologies are covered within the framework of this course, which eventually outlines the background of the more technological courses offered in the following semesters.
Course learning outcomes	1. Ability to apply knowledge of mathemathics, science and engineering. 2. Ability to design a system, a product component and process with all desired requirements. 3. Ability to decide, formulize and solve engineering problems. 4. An extensive education for understanding engineering solutions globally and socially. 5. Aim for students to understand the importance of life-time learning and learn that ability. 6. Aim for students to be aware of recent and modern subjects. 7. Ability of students to use necessary techniques, skills and modern engineering equipments for engineering applications. 8. Ability to design and process a system, a product and/or a process for the benefit of humanity, protection of the nature and for considering resources in the most efficient way while meeting the recent necessarities in quality and environmental issues.
Textbook	H.A. Fine and G.H. Geiger, Handbook on Material and Energy Balance Calculations in Metallurgical Processes, A publication of TMS, 1993.
Other references	• J.C. Whitwell and R.K. Toner, Conservation of Mass and Energy, McGraw-Hill Book Company. • Butts, Metallurgical Problems, McGraw-Hill, 1943. • V. Aytekin, Metalurji Problemleri, İTÜ Matbaası, 1978. • R. Schuhmann, Metallurgical Engineering, Vol.1, Engineering Principles, Addison Wesley Pub. Co., 1952.
Homework & Projects	All homework problems are to be handed-in a week after they are assigned. Homework problems may be used as a source for exams.
Laboratory work	NONE
Computer use	Being able to work with computer programs MS Word and MS Excel
Other activities	NONE

Assessment criteria		**Quantity**	**Effects on grading, %**
	Activities	**-**	**-**
	Midterm exam	**1**	**25 %**
	Quiz	**3**	**15 %**
	Homework	**3**	**15 %**
	Project	**-**	**-**
	Term Paper/Project		**-**
	Laboratory Work	**-**	**-**
	Other Activities	**-**	**-**
	Final exam	**1**	**45 %**

COURSE PLAN

Weeks	Topics	Course outcomes
1	Dimensions, System of Units and Conversion Factors; molar units, density, concentration.	1
2	Stoichiometry; atomic and molecular mass, chemical equations	1
3	Excess and limiting reactants, oxidation and reduction	1
4	Sampling and Measurements Procedures; description of error, precision, accuracy and repeatability, measurement of weight, pressure, flow rate, etc	1-5
5	Sampling and Measurements Procedures; description of error, precision, accuracy and repeatability, measurement of weight, pressure, flow rate, etc	1-5
6	Material Balances; conservation of mass, mass balance analyses	1-3
7	Material Balances; conservation of mass, mass balance analyses	1-3
8	Mass balance analyses, systems with or without chemical reaction	1-3
9	Recycling & by-pass circuits	1-8
10	Recycling & by-pass circuits	1-8
11	Energy Balances; heat balance, electrometallurgical and electrothermic energy balances	1-8
12	Energy Balances; heat balance, electrometallurgical and electrothermic energy balances	1-8
13	Differential Heat balances, simultaneous material and energy balances, process analysis.	1-8
14	Examples of materials and energy balances for metallurgical reactors	1-8

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)			
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)			
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)			
7	An understanding of current/contemporary issues and impact of engineering solutions in broad cultural, national and global levels (ABET:h, j)			
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)			
9	Ability to use essential tools and techniques of modern engineering in the development, production, processing, protecting 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. Bora DERİN	December 2020	