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	1. Fundamental concepts in the field of Metallurgical and Materials Engineering, 2. Solving numerical examples from the existing industrial applications almost all processes, utilized in metal production technologies, 3. Forming the mass and energy balances for the complex industrial applications and effectively resolving them, 4. Outlines the background of the more technological courses offered in the following semesters.
Course Learning Outcomes	1. Ability to apply knowledge of mathematics, 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 necessities 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	1. J.C. Whitwell and R.K. Toner, Conservation of Mass and Energy, McGraw-Hill Book Company. 2. Butts, Metallurgical Problems, McGraw-Hill, 1943. 3. V. Aytekin, Metalurji Problemleri, İTÜ Matbaası, 1978. 4. 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	-
Computer Use	Being able to work with computer programs MS Word and MS Excel
Other Activities	-

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

	Student 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	**X**		
4	An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, 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 judgement 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**		**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 AND GLASS		**X**	
	POLYMER			
	COMPOSITES			
	BIOMATERIALS		**X**	

1: Little, 2: Partial, 3: Full

Prepared by	**Date**	**Revision #**	**Signature**
Prof. Dr. C. Bora DERİN Assoc. Prof. Dr. M. Şeref SÖNMEZ	December 2020		