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 Department					
Course Type	Required		**Course Language**	English		
Course Prerequisites	None					
Course Category by Content, %	**Basic Sciences**	**Engineering Science**	**Engineering Design**	**General Education**		
		80	20			
Course Description	Dimensions, System of Units, Conversion Factors, Process Variables, Stoichiometry, Balancing Chemical Equations, Excess and Limiting Reactants, Yield & Selectivity, Oxidation and Reduction, Description of Error, Precision, Accuracy and Repeatability, Measurement of weight, pressure, flow rate, Fundamentals of Material Balance Calculations, General Balance Equation, Procedure for Single-unit Process Material Balance Calculations, Balances on Multiple-unit Processes, Degree of Freedom Analysis, Recycling & By-pass Circuits, Balances on Continuous Steady-State Processes, Integral Balances on Batch, Semi-Batch and Continuous Processes, Systems with or without Chemical Reaction, Solution of sets of linear/non-linear equations: Introduction to computer aided tools for solving sets of linear equations, Energy Balances, Heat balance, Electrometallurgical Energy Balances, Simultaneous Material and Energy Balances, 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 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 equipment 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	Handbook on Material and Energy Balance Calculations in Material Processing, 3rd Ed., Arthur E. Morris, Gordon Geiger, H. Alan Fine, Wiley, 2011.					

Other References	• Basic Principles and Calculations in Chemical Engineering, David M. Himmelblau, Prentice Hall, 2004. • Elementary Principles of Chemical Processes, Richard M. Felder and Ronald W. Rousseau, 3rd Ed., John Wiley & Sons, Inc., 2000. • Elements of Chemical Reaction Engineering, Fogler H.S., 4th Ed., Prentice-Hall, 2006. • Mass and Energy Balances in Materials Engineering, M.E. Schlesinger, Prentice-Hall, 1996.		
Homework & Projects	None		
Laboratory work	None		
Computer use	Working knowledge of MS Excel is helpful		
Other activities	None		
Assessment Criteria	**Activities**	**Quantity**	**Effects on grading, %**
	Midterm exam	2	40
	Quiz	3	15
	Homework	-	-
	Project	-	-
	Term Paper/Project	-	-
	Laboratory Work	-	-
	Other Activities	-	-
	Final exam	1	45

COURSE PLAN

Weeks	Topics	Course outcomes
1	Dimensions, System of Units, Conversion Factors	1
2	Stoichiometry, Balancing Chemical Reactions	1
3	Excess and Limiting Reactants, Yield & Selectivity, Oxidation and Reduction	1
4	Description of Error, Precision, Accuracy and Repeatability, Measurement of weight, pressure, flow rate	1, 5
5	Fundamentals of Material Balance Calculations, General Balance Equation	1, 5
6	Procedure for Single-unit Process Material Balance Calculations	1, 3
7	Material Balances; conservation of mass, mass balance analyses	1, 3
8	Balances on Multiple-unit Processes, Degree of Freedom Analysis	1, 3
9	Recycling & By-pass Circuits, Balances on Continuous Steady-State Processes	1-9
10	Integral Balances on Batch, Semi-Batch and Continuous Processes	1-9
11	Systems with or without Chemical Reaction, Solution of sets of linear / non-linear equations: Introduction to computer aided tools for solving sets of linear equations	1-9
12	Energy Balances, Heat balance, Electrometallurgical Energy Balances	1-9
13	Simultaneous Material and Energy Balances	1-9
14	Examples of Materials and Energy Balances for Metallurgical Reactors	1-9

Relationship between the Course and Metallurgical and Materials Engineering Curriculum

	Student 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 ELEMENTS OF THE FIELD	STRUCTURE		X	
	PROPERTIES			X
	DESIGN EXPERIMENT/ANALYSE DATA		X	
	PROCESSING		X	
	COST/PERFORMANCE			
	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. Cüneyt ARSLAN Doç.Dr. Cevat Bora DERİN	December 2017	