Course Name						
FUNDAMENTALS OF TRANSPORT PHENOMENA						
Code	Semester	Local Credits	ECTS Credits	Course Implementation, Hours/Week		
				Theoretical	Tutorial	Laboratory
MET 317E	5	2.5	4	2	1	-

Department/Program	Metallurgical and Materials Engineering			
Course Type	Required	**Course language**	English	
Course Prerequisites	MET 213E			
Course Category by Content, %	**Basic Sciences**	**Engineering Science**	**Engineering Design**	**General Education**
	-	80	20	-
Course description	Introduction and basic concepts, Dimensions and units of measurement, General overview of transport phenomena including various applications, Types of fluid flow and Reynolds number, The concept of viscosity & kinematic viscosity and viscosity calculations of fluids, Newton's law, Newtonian and non-Newtonian fluids, Applications of differential equations of flow, Laminar Flow & Momentum Balance, Equation of continuity and the momentum equation, Application of Navier-Stokes' equation, Turbulent and complex flows, Heat transfer mechanisms, Fourier's law of heat conduction, Thermal conductivity of materials, Conduction of heat in solids, Definition of fluxes-Fick's laws, Diffusion in different media (solids, ceramics materials, liquids, etc.)			
Course objectives	The objective of this engineering course is to provide to the student a sufficient background to be able to understand the fundamental phenomena, governing equations and assumptions used in the analysis of transport processes. We address aspects of three fundamental transport processes, momentum, heat and mass. After completing the class, students will be able to develop a background in the transports phenomena which are significant to be successful in many theoretical and practical problems in the fields of the laboratory practices, pilot plants or industrial operations implementations.			
Course learning outcomes	Upon successful completion of this course, a student should be able to: 1. Ability to apply knowledge of mathematics (calculus and differential equations) and physics (laws of conservations of mass, momentum and energy) to transport phenomena related to materials, 2. Ability to analyze transport phenomena related to materials, by formulating the problems mathematically (into differential equations with proper boundary conditions) and solving them analytically or with the help of equation-solving tools, 3. Ability to design materials processing (e.g., casting, welding, heat treating, crystal growth and semiconductor processing) based on transport phenomena, 4. Knowledge of contemporary issues in transport phenomena in materials processing, e.g., computer simulation of materials production and processing.			
Textbook	1. Transport Phenomena in Materials Processing, D.R. Poirier, G.H. Geiger, The Minerals, Metals & Materials Society, 2016. 2. Fundamentals of Fluid Mechanics, B.R. Munson, T.H. Okiishi, W.W. Huebsch, A.P. Rothmayer, 7th Ed., Wiley & Sons, 2012.			
Other references	1. Transport and Chemical Rate Phenomena, Themelis N.J., Gordon & Breach, 1995. 2. Transport Phenomena, Bird R.B., Stewart W.E., and Lightfoot E.N., Wiley, 1960. 3. Rate Phenomena in Process Metallurgy, Szekely J. and Themelis N.J., Wiley-Interscience, 1971. 4. Transport Phenomena in Metallurgy, Geiger G.H. and Poirier D.R., Addison-Wesley, 1973. 5. Transport Processes: Momentum, Heat, and Mass, Geankoplis C.J., Allyn & Bacon, Inc., 1983.			
Homework & projects	-			
Laboratory work	-			
Computer use	-			
Other activities	-			

Assessment criteria	**Activities**	**Quantity**	**Effects on grading, %**
	Midterm exams	**2**	**30**
	Quizzes	**-**	**-**
	Homework	**-**	**-**
	Projects	**-**	**-**
	Term Paper/Project		**-**
	Laboratory Work	**-**	**-**
	Other Activities	**-**	**-**
	Final exam	**1**	**40**

COURSE PLAN

Weeks	Topics	Course Outcomes
1	Introduction to transport phenomena; Basic concepts	1
2	Properties of Fluids; Types of fluid flow and Reynolds number, Newton's Law, Viscosity and Kinematic viscosity, Viscosity of gases, Example problems	1,2
3	Properties of Fluids; Viscosity of liquids, Non-Newtonian fluids, Example problems	1,2
4	Laminar Flow & Momentum Balance: Momentum balance, Flow of a falling film, Fully developed flow between parallel plates, Fully developed flow through a circular tube, Example problems	1,2,3
5	Laminar Flow & Momentum Balance: Equation of continuity and the momentum equation, Application of Navier-Stokes' equation, Example problems	1,2,3,4
6	Turbulent and complex flows: Friction factors for flow in tubes, Flow in noncircular conduits, Flow past submerged bodies,	1,2,3
7	Turbulent and complex flows: Flow through porous media, Fluidized beds, Example problems	1,2,3,4
8	Turbulent and complex flows: Fluidized beds, Example problems	1,2,3,4
9	Fourier's Law & Thermal conductivity of materials, Example problems	1,2,3
10	Thermal conductivity of materials, Example problems	1,2,3
11	Conduction of heat in solids: The energy equation for conduction, Steady-state one-dimensional systems, Transient systems, Finite dimensions, Example problems	1,2,3,4
12	Conduction of heat in solids: Transient conditions, Infinite and semi-infinite, Example problems	1,2,3,4
13	Fluxes-Fick's laws, Diffusion in solids, Example problems	1,2,3,4
14	Diffusion in ceramic materials, Diffusion in semiconductors, Diffusion in liquids, Diffusion in gases, Example problems	1,2,3,4

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, analyse 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			
	PROPERTIES		X	
	DESIGN EXPERIMENT/ANALYSE DATA		X	
	PROCESSING		X	
	COST/PERFORMANCE			
	QUALITY/ENVIRONMENT			
	DESIGN PROCESS OR PRODUCT		X	
MATERIAL CLASSES	METAL			X
	CERAMICS AND GLASS		X	
	POLYMER			
	COMPOSITES		X	
	BIOMATERIALS			

1: Little, 2: Partial, 3: Full

Prepared by	Date	Revision #	Signature
Assoc.Prof. Dr. Güldem KARTAL ŞİRELİ	December 2020		