Course Name						
Ceramic Materials						
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Course Implementation, Hours/Week**		
				Theoretical	**Tutorial**	**Laboratory**
MET 451 E	7	3	5	3	-	-

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**
	-	80	20	-

Course Description	Ceramic materials description, bonding structures, crystal structures, ceramic phase systems, physical and mechanical properties of ceramics, ceramic raw materials, technical ceramic raw materials, advanced ceramic raw materials, ceramic raw materials preparation, ceramic forming process, sintering theory, sintering methods, sintering parameters, finishing of ceramic parts.
Course Objectives	1. To provide metallurgy and materials engineering students' fundamental engineering knowledge and skill, by teaching structures and bondings of ceramic materials and make relations between structures and some physical and mechanical properties. 2. To provide the knowledge of ceramic materials processing and sintering theory, the interaction starting materials properties, production processing, sintering parameters, on microstructure and properties of technical ceramics. 3. To give ability to apply knowledge of technical ceramics on engineering problems.
Course Learning Outcomes	Students who pass the course will be able to: 1. Understand ceramic bonds characteristics, ceramic structures and interactions of ceramic properties between atomic bonds and crystal structures 2. Understand important binary and ternary phase systems in ceramic materials, 3. Understand and how measures physical and mechanical properties of ceramic materials, 4. Know about ceramic raw materials and how to prepare ceramic materials, 5. Explain ceramic forming techniques, and important parameters of them, 6. Understand sintering theory, sintering processes, sintering parameters, 7. Understand relation between raw materials, sintering process and properties of ceramic materials, Understand inwhich situations ceramic materials have better advantages over other engineering materials
Textbook	• Ceramic Materials-Science&Engineering,C.B. Carter, M.G. Norton, Springer 2007 • Ceramic Materials, Processes, Properties and Applications, P. Boch, J.C.Niepce ISTE 2007
Other References	• Introduction To Ceramics, W.D. Kingery Wiley , 1960
Homework & Projects	• 1 Homework is given for the participation of students to the course and it will be mandatory to take the final exam. Homework problems may be used as a source on the final exam.
Laboratory Work	
Computer Use	
Other Activities	

Assessment Criteria	**Activities**	**Quantity**	**Effects on Grading, %**
	Midterm Exams	2	50
	Quizzes		
	Homework	1	-
	Projects		
	Term Paper/Project		
	Laboratory Work		
	Other Activities		
	Final Exam	1	50

COURSE PLAN

Weeks	Topics	Course Outcomes
1	Introduction to ceramic materials, description of ceramic materials properties, properties-microstructure-sintering process, brief history of ceramic materials, classification of ceramic materials.	I
2	Ceramic crystal structures, bonds in ceramic materials	I
3	Crystal structures, crystal directions and planes, ceramic crystal chemistry, ceramic crystal structures.	I
4	Phase equilibria and phase equilibrium diagrams in ceramics, phase rule, binary phase rule, one component, two component and three component systems, solid solutions, important phase diagrams	II
5	Properties of ceramic materials, physical properties of ceramics, thermal properties of ceramics, mechanical properties of ceramics, toughening mechanisms.	III
6	Electrical properties of ceramics, dielectrical, magnetic and optical properties	III
7	Powder processing, ceramic raw materials; traditional ceramic raw materials;	IV
8	ceramic clays, kaolin, quartz, feldspar, wollastonite, talc, advanced ceramic raw materials; aluminum oxide, zirconium oxide	IV
9	Magnesium Oxide, silicon carbide, silicon nitride	IV
10	Raw materials Selection Criteria, purity, particle size and reactivity, Powder preparation and sizing, Mechanical sizing, Chemical sizing, Mixing, Reconsolidation, Additives,Spray Drying, Composition Calculation	IV
11	Shape forming Processes, Pressing, Step in Pressing, Selection of Additives, Uniaxial Pressing, Isostatic Pressing, Application of Pressing, Casting, Slip Casting, Extrusion, Injection Molding	V-VII
12	Densification, Theory of Sintering, Sintering Stages, Sintering Mechanism	VI-VII-VIII
13	Control of Conventional Sintering, Sintering Atmosphere, Time/Temperature Cycle, Design of the Furnace,	VI-VII-VIII
14	Sintering Problems, Hot Pressing, Hot Isostatic Pressing, Spark Plazma Sintering	VI-VII-VIII

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)	X		
3	Ability to design a system or a process, taking into consideration of the desired specifications, quality, ethics and environment. (ABET:c)	X		
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)	X		
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)		X	
9	Ability to use essential tools and techniques of modern engineering in the development, production, processing, protecting and surface treatment 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			
	PROCESSING			X
	COST/PERFORMANCE		X	
	QUALITY/ENVIRONMENT	X		
	DESIGN PROCESS OR PRODUCT			X
MATERIAL CLASSES	METAL			
	CERAMICS			X
	POLYMERS			
	COMPOSITES	X		

1: Little, 2. Partial, 3. Full

Prepared by	Date	Signature
Assoc.Prof.Filiz Şahin	5.5.2009	