Course Name							
POWDER METALLURGY							
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Course Implementation, Hours/Week**			
				Theoretical	**Tutorial**	**Laboratory**	
MET 475E	7	2	4	2	0	-	
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**			
		40 %	60 %				
Course Description	This course aims to introduce powder metallurgy (P/M) technique and its engineering applications.P/M is a processing approach which is a subdivision of metalworking technologies. It offers net-shape or near-net-shape fabrication which is a key objective and main advantages of this method compared to other competative processes. The process basicly involves transforming powders into consolidated products while desired material properties are attained via adjusting initial powder chemistry, selecting shaping technology, applying necessary sintering practice and heat treatments to reach final microstructure						
Course Objectives	**1.** To introduce the field of Powder Metallurgy and engineering applications; from historical background to contemporary advanced applications **2.** To introduce and explain basic methodologies and techniques for metal powder production **3.** To describe important powder characteristics, and related characterization techniques. **4.** To explain basic shaping and consolidation technologies applied in P/M and preparation necessary powder mixtures necessary to them. **5.** To explain sintering phenomena and related sintering technologies **6.** To provide information on secondary operations applied in P/M and introduce some of contemporary P/M engineering applications.						
Course Learning Outcomes	**1.** To understand the field of Powder Metallurgy and learn basic engineering need to use this technique. **2.** To learn different metal powder production methods and general trends in powder production. **3.** To understand basic powder characteristics and how to control them. **4.** To understand powder compaction process and different shaping technologies and necessary powder treatments. **5.** To learn basic sintering theory and various sintering densification methodologies and related technology. **6.** To learn different secondary operations applied in P/M and some of contemporary P/M engineering applications.						
Textbook	-Powder Metallurgy Science, Randall M. German, MPIF, 1994						
Other References	- Powder Metal Technologies and Applications, ASM Handbook Vol:7, 1998.						
Homework & Projects	Each student will prepare a Term Paper related to contemporary P/M engineering applications and present it during last two weeks the semester. According to number of students enrolled to the course this work is either performed individually or as in groups and will be decided by lecturer.						
Laboratory Work	none						
Computer Use							
Other Activities							
Assessment Criteria	**Activities**	**Quantity**	**Effects on Grading, %**				
	Midterm Exams	1	30				
	Quizzes						
	Homework	1	25				
	Projects						
	Term Paper/Project						
	Laboratory Work						
	Other Activities						
	Final Exam	1	45				

COURSE PLAN

Weeks	Topics	Course Outcomes
1	Introduction to Powder Metallurgy (P/M) and its engineering applications	**I**
2	Metal powder production methods - 1	**II**
3	Metal powder production methods - 2	**II**
4	Powder characterization and testing - 1	**III**
5	Powder characterization and testing - 2	**III**
6	Shaping and consolidation technologies-1: Powder Treatments and Lubrication	**II-IV**
7	Shaping and consolidation technologies-2: Basic Shaping and Pressing Technologies, Presses and Tooling	**IV**
8	Shaping and consolidation technologies-3: Alternative Shaping technologies	**IV-V**
9	Shaping and consolidation technologies-4: Solid state and Liquid phase sintering	**IV-V**
10	Shaping and consolidation technologies-5: Sintering Furnaces and Atmospheres	**V-VI**
11	Shaping and consolidation technologies-6: Alternative Sintering technologies	**V-VI**
12	Secondary operations in P/M	**VI**
13	Materials systems, properties and applications in P/M	**VI**
14	Advances in P/M applications.	**VI**

Relationship between the Course and the 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)		X	
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			**X**
	CERAMICS	**X**		
	POLYMERS	**X**		
	COMPOSITES	**X**		

1: Little, 2. Partial, 3. Full

Prepared by	**Date**	**Signature**
Assoc. Prof. Dr. BURAK ÖZKAL	March, 2013	