COURSE PLAN

Course Name						
ENERGY MATERIALS						
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Course Implementation, Hours/Week**		
				Theoretical	**Tutorial**	**Laboratory**
MET 366E	6	2	4	2		

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	40	20

Course Description	Introduction to Energy and its use and importance in Metallurgy and Materials Engineering, History of Energy: from Aristotle to Einstein, Introduction to different forms of energy. Materials for Energy Harvesting (solar energy materials, photovoltaic materials, materials for wind and nuclear power, thermoelectric materials, materials used in fuel cell technology and their manufacturing methods). Materials used in energy storage (batteries, capacitors, hydrogen storage and their applications). Materials Enabling Energy- Efficient Transportation. Materials for housing (lighting, heating and cooling). Materials used for energy efficiency in industry. Novel Materials for Energy Applications and R&D trends for energy materials. Energetic Materials (basic principles, manufacturing processes, applications).
Course Objectives	1.To describe materials used in various energy harvesting and storage industries and teach their manufacturing processes. 2.To explain the importance of energy efficiency, introduce the materials providing energy efficiency both in everyday life and industry and teach the novel studies for energy efficient materials.
Course Learning Outcomes	Students who pass the course will be able to: 1. Identify the importance of energy for Metallurgical and Materials Engineering, learn the historical developments behalf of energy and are informed of different forms of energy. 2. Learn the materials used in various energy harvesting industries such as solar, wind, nuclear and thermoelectric and manufacturing processes of these materials. 3. Know the materials utilized in energy transformation technologies such as fuel cells. 4. Learn the materials which are used in batteries, capacitors and hydrogen storage and properties required for their applications. 5. Comprehend materials enabling energy- efficient transportation. 6. Learn the materials which prevent serious consumptions of energy in everyday life such as lighting, cooling and heating. 7. Know which materials are used for energy efficiency in industrial processes. 8. Identify the novel materials and technologies used in energy applications and are informed of latest developments made for energy saving in materials science. 9. Comprehend basic principles, manufacturing processes and applications of the materials with high formation enthalpies.
Textbook	Kreith F. ve Goswami D. Y., Handbook of Energy Efficiency and Renewable Energy, Taylor & Francis, 2007.
Other References	Martin F., Materials for Energy Systems, Concise Encyclopedia of Materials for Energy Systems, Elsevier, 2008. Mezzane D., Luk'yanchuk I., Smart Materials for Energy, Communications and Securtiy, Springer, 2008. Agrawal J. P., High Energy Materials Propellants, Explosives and Pyrotechnics, Wiley- Vch, 2010.
Homework & Projects	-
Laboratory Work	-
Computer Use	-
Other Activities	**-**

Assessment Criteria	**Activities**	**Quantity**	**Effects on Grading, %**
	Midterm Exams	**2**	**60**
	Quizzes		
	Homework		
	Projects		
	Term Paper/Project		
	Laboratory Work		
	Other Activities	**-**	**-**
	Final Exam	**1**	**40**

COURSE PLAN

Weeks	Topics	Course Outcomes
1	Introduction to Energy and its use in Metallurgy and Materials Engineering, History of Energy: from Aristotle to Einstein, Introduction to different forms of energy	I
2	Materials for Energy Harvesting (Solar Energy Materials and Photovoltaic Materials)	I
3	Materials for Energy Harvesting (Materials for Wind and Nuclear Power)	I
4	Materials for Energy Harvesting (Thermoelectric Materials)	II
5	Materials for Energy Transformation (Fuel Cell Materials and Components)	II
6	Materials for Energy Transformation (Fuel Cell Materials and Components) MID – TERM EXAM	II
7	Materials for Energy Storage (Materials for Batteries and Capacitors)	III
8	Materials for Energy Storage (Hydrogen Storage Materials)	III
9	Materials Enabling Energy- Efficient Transportation	IV
10	Materials for Lighting and Cooling	IV
11	Materials for Industrial Energy Efficiency	V
12	Novel Materials for Energy Applications	V
13	Novel Materials for Energy Applications MID – TERM EXAM	VI
14	Energetic Materials and their applications	VI

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)		X	
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 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	**x**		
	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**
Prof. Dr. Onuralp Yücel	March 2013	