Course Name						
MATERIALS PHYSICS						
				Course Implementation, Hours/Week		
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Theoretical**	**Tutorial**	**Laboratory**
MET 246E	4	2	3	2	-	-

Department/Program	Metallurgical and Materials Engineering			
Course Type	Required		**Course Language**	ENGLISH
Course Prerequisites	None			
Course Category by Content, %	**Basic Sciences**	**Engineering Science**	**Engineering Design**	**General Education**
	30	60	10	
Course Description	Atomic structure and introduction to quantum mechanic; Understanding the Schrödinger Wave Equation, Wave nature of matter; Generation of X ray; Atomic structure and magnetism; Electromagnetic spectrum; Sources of light; Colour and appearance; Reflection, scattering, diffraction; The quantum mechanical description of atomic binding; the crystalline state and amorphous state; Elastic compliance and stiffness constants; Electrical polarization of ionic crystals; Piezo electricity; Modes of vibrations; Phonons; theory of heat capacity, temperature, thermal conductivity, thermal expansion; Free electron and band gap theory; Superconductivity			
Course Objectives	1. To make the importance and role of the materials science in the engineering applications understood. 2. To teach the quantum physics theories related with the properties and structure of materials and to make the students understand the strong relations between them. 3. To give a physics background for understanding the classification of engineering materials with respect to their properties			
Course Learning Outcomes	After completing this course the student will be able to understand: 1. Basic concept of quantum mechanics 2. The electronic structure of atoms and electronic properties of materials 3. Electromagnetic spectrum, sources of light and definition of colour 4. The quantum mechanical description of atomic binding, elasticity, lattice vibration and phonons 5. Energy and heat concept 6. Atomic background of magnetism 7. Behaviour of ionic crystals under stress and deformation			
Textbook	• Fredriksson H., Akerlind U., “Physics of Functional Materials,” Wiley 2008, ISBN: 978-0-470-51757-4. • Livingston J.D. , “Electronic Properties of Engineering Materials,” Wiley 1999, ISBN: 978-0-471-31627-5 • Hummel R.E., “Electronic Properties of Materials”, 3rd Ed., Springer 2005, ISBN No: 0-387-95144-X. • White M.A., “Properties of Materials”, Oxford University Press 1999, ISBN No: 978-0195113310.			
Other References	• Kasap S.O., “Principles of Electrical Engineering Materials and Devices”, Revised Edition, McGraw – Hill 2000, ISBN No: 0-07-116471-5. • Neamen D.A., “Semiconductor Physics and Devices: Basic Principles”, 3rd ed., McGraw-Hill 2003, ISBN No: 0-07-119862-8			
Homework & Projects				
Laboratory Work	none			
Computer Use				
Other Activities				

Assessment Criteria	**Activities**	**Quantity**	**Effects on Grading, %**
	Midterm Exams	MIN 1	30
	Quizzes	2	10
	Homework	-	-
	Projects	-	-
	Term Paper/Project	-	-
	Laboratory Work	-	-
	Other Activities	-	-
	Final Exam	1	60

COURSE PLAN

Weeks	Topics	Course Outcomes
1	**Atomic Structure, Binding and Introduction to Quantum Mechanic:** (Early ideas of Atomic structure, Wave-particle duality, Introduction to quantum Mechanic, Understanding the Schrödinger Wave Equation, Wave nature of matter)	1
2	**Atomic Structure, Binding and Introduction to Quantum Mechanic:** (Early ideas of Atomic structure, Wave-particle duality, Introduction to quantum Mechanic, Understanding the Schrödinger Wave Equation, Wave nature of matter)	1
3	**Electron configuration of atoms:** (The electronic structure of atoms and periodic table, Electron configuration of transition metals, Quantum mechanics and energy levels, Generation of X ray)	1, 2
4	**Electrical Conduction in Solids:** (Free electron theory, Band gap theory, Fermi-Dirac Equation, Semiconducting, Superconductivity)	2
5	**Electrical Conduction in Solids:** (Free electron theory, Band gap theory, Fermi-Dirac Equation, Semiconducting, Superconductivity)	2
6	**Optical aspects of matter:** (Electromagnetic spectrum, Sources of light, Color and appearance, Refraction and dispersion, Reflection, Scattering, Diffraction, Polarization in optics)	3
7	**Optical aspects of matter:** (Electromagnetic spectrum, Sources of light, Color and appearance, Refraction and dispersion, Reflection, Scattering, Diffraction, Polarization in optics)	3
8	**Crystal and amorphous structures:** (The bonding of atoms, The quantum mechanical description of atomic binding, The crystalline state, Amorphous state)	4
9	**Lattice vibration and phonons:** (Modes of vibrations and Phonons)	4
10	**Energy and Heat:** (Heat Capacity, theory of heat capacity, temperature, thermal conductivity, quantum and classical theories in heat, thermal expansion)	5
11	**Energy and Heat:** (Heat Capacity, theory of heat capacity, temperature, thermal conductivity, quantum and classical theories in heat, thermal expansion)	5
12	**Magnetism and Electromagnetism:** (Atomic background of magnetism, Induction, Electromagnetic waves)	6
13	**Ionic Crystals:** (Electrical Polarization of ionic crystals, Behaviour of ionic crystals under stress and deformation, Ferroelectric crystals, Piezo electricity)	7
14	**Elasticity in Crystals:** (Elastic Compliance and Stiffness Constants, Determination of elastic constants, Elastic Waves in Crystals)	4

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)			
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			
	COST/PERFORMANCE			
	QUALITY/ENVIRONMENT			
	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. Kürşat KAZMANLI	December 2020	