Course Name						
ELECTRONIC, MAGNETIC,OPTICAL PROPERTIES OF MATERIALS						
				Course Implementation, Hours/Week		
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Theoretical**	**Tutorial**	**Laboratory**
MET 335E	5	2,5	5	2	1	-

Department/Program	Metallurgical and Materials Engineering			
Course Type	Required	**Course Language**	ENGLISH	
Course Prerequisites	MET 246E			
Course Category by Content, %	**Basic Sciences**	**Engineering Science**	**Engineering Design**	**General Education**
		60	40	

Course Description	This course covers :electrical conductivity and resistivity of materials, the factors affecting the conductivity of materials, metals, semiconductors and isolators, extrinsic and intrinsic semiconductors, single crystal materials, electronic device fabrication concept, electronic, optoelectronic and renewable energy devices, optical properties of materials, solder materials, printed circuit boards and solder materials, dielectric and ferro-electric materials, effects of electron configurations on the magnetic behavior of materials, classification of magnetization and magnetic materials, heat capacity, thermal expansion and thermal conductivity of materials.
Course Objectives	1. To teach the electronic, magnetic, thermal and optical properties of engineering materials. 2. To make the students understand the relation between the electronic properties and the electron bands of conductors and semiconductors. 3. To give an understanding of the basic electronic device theories and the production processes. 4. To teach the effects of micro structure on the electronic, magnetic and optical properties of materials.
Course Learning Outcomes	After completing this course the student will be able to understand: 1. Classification of the material depending on its electron band structure and the effects of the microstructure and the temperature on electric conductivity, 2. Electronic – optoelectronic devices and their fabrication concepts, 3. Renewable energy devices, 4. Piezoelectric effects and the crystal structure of the piezo electric materials. The students also will be able to use piezo electric effect equations. 5. Magnetization in the materials and the relation between the magnetic properties and the electron configuration of the materials. 6. Heat capacity, thermal conduction and thermal expansion and utilize them in the related problem solutions. 7. The optical properties of materials.
Textbook	• Hummel, R.E., "Electronic Properties of Materials", 3rd Ed., Springer, 2005, ISBN No: 0-387-95144-X. • 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 • White, M.A., "Properties of Materials", Oxford University Press, USA,1999, ISBN No: 978-0195113310.
Other References	• Schaffer, P., Saxena, A., Sanders, T.H., Antolovich, S.D., Warner, S.B., "Science and Design of Engineering Materials", J, McGraw-Hill, 2000, ISBN 9780072448092. • Mitchell, B.S., "An Introduction to Materials Engineering and Science for Chemical and Materials Engineers", John Wiley&Sons, 2004. • Harper C.A., Sampson R.M., "Electronic Materials & Processes Handbook," 2nd ed., McGraw-Hill International Edition 1994, ISBN 0-07-113363-1
Homework & Projects	
Laboratory Work	none
Computer Use	
Other Activities	

Assessment Criteria	**Activities**	**Quantity**	**Effects on Grading, %**
	Midterm Exams	MIN 1	35
	Quizzes	-	-
	Homework	MIN 1	5
	Projects	-	-
	Term Paper/Project	-	-
	Laboratory Work	-	-
	Other Activities	-	-
	Final Exam	1	60

COURSE PLAN

Weeks	Topics	Course Outcomes
1	**Periodic Table and Conductors, resistors and insulators:** (Conductors, Resistors and Seeback effects, Thermistors, Polymers and Ceramics)	1
2	**Semiconductors:** (Intrinsic semiconductors, extrinsic semiconductors, compound semiconductors, III-V Semiconductors, Oxide semiconductors, Bulk Semiconductor Crystal Growth, Wafer Preparation)	1, 2
3	**Semiconductors:** (Intrinsic semiconductors, extrinsic semiconductors, compound semiconductors, III-V Semiconductors, Oxide semiconductors, Bulk Semiconductor Crystal Growth, Wafer Preparation)	1, 2
4	**Semiconductors:** (p-n Junction: Rectifier Diodes, Schottky Diodes and Zener Diodes, Bipolar Junction Transistors: npn and pnp transistors, FET and MOSFET, Photoconductor, MEMS – NEMS, Hall Effect Devices, Peltier Devices, Gas Sensors)	2
5	**Semiconductors:** (p-n Junction: Rectifier Diodes, Schottky Diodes and Zener Diodes, Bipolar Junction Transistors: npn and pnp transistors, FET and MOSFET, Photoconductor, MEMS – NEMS, Hall Effect Devices, Peltier Devices, Gas Sensors)	2
6	**Semiconductors:** (p-n Junction: Rectifier Diodes, Schottky Diodes and Zener Diodes, Bipolar Junction Transistors: npn and pnp transistors, FET and MOSFET, Photoconductor, MEMS – NEMS, Hall Effect Devices, Peltier Devices, Gas Sensors)	2
7	**Lithography and Photo-fabrication**	2
8	**Optics, Optoelectronics and Lasers:** (Photo detectors, LEDs, Liquid Crystal Displays, Solid State Lasers, Gas Lasers, Quantum Well Lasers, Optical Filters)	2, 7
9	**Optics, Optoelectronics and Lasers:** (Photo detectors, LEDs, Liquid Crystal Displays, Solid State Lasers, Gas Lasers, Quantum Well Lasers, Optical Filters)	2, 7
10	**Renewable Energy Devices:** (Solar Cells, Fuel Cells)	3
11	**Solder Materials:** (Tin-Lead Solders, Lead Free Solders, Hard Solders, Solder Pastes, Soldering Applications)**Printed Circuit Boards:** Printed Circuit Board Materials, Double sided and multi layer boards, Through Hole Coatings, Flexible Printed Circuit Boards)	2
12	**Magnetic Materials:** (Diamagnetic, Paramagnetic, Ferromagnetic, Ferrimagnetic and Anti-ferromagnetic Materials, Soft Magnets, Hard Magnets, Superconducting Magnets)	5
13	**Ionic Crystals and Piezo Electricity:** (Ionic crystals and ionic polarization, Piezo Electric Effect Applications) **Dielectric Materials and Capacitors**	4
14	**Heat Properties of Materials:** (Heat Conductors and thermal expansion, Bi-metals and Thermostats, Temper Glasses)	6

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 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			
	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	