<table>
<tr><td colspan="8">Course Name</td></tr>
<tr><td colspan="8">ELECTRONIC, MAGNETIC, OPTICAL PROPERTIES OF MATERIALS</td></tr>
<tr><th rowspan="2">Code</th><th rowspan="2">Semester</th><th rowspan="2">Local Credits</th><th rowspan="2">ECTS Credits</th><th colspan="3">Course Implementation, Hours/Week</th></tr>
<tr><th>Theoretical</th><th>Tutorial</th><th>Laboratory</th></tr>
<tr><td>MET 335E</td><td>5</td><td>2.5</td><td>5</td><td>2</td><td>1</td><td>-</td></tr>
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Department/Program	Metallurgical and Materials Engineering			
Course Type	Required	**Course Language**	English	
Course Prerequisites	MET246E			
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	1.Hummel, R.E., “Electronic Properties of Materials”, 3rd Ed., Springer, 2005, ISBN No: 0-387-95144-X. 2.Kasap, S.O., “Principles of Electrical Engineering Materials and Devices”, Revised Edition, McGraw – Hill, 2000, ISBN No: 0-07-116471-5. 3.Neamen, D.A., “Semiconductor Physics and Devices: Basic Principles”, 3rd ed., McGraw-Hill, 2003, ISBN No: 0-07-119862-8 4.White, M.A., “Properties of Materials”, Oxford University Press, USA,1999, ISBN No: 978-0195113310.
Other References	1.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. 2.Mitchell, B.S., “An Introduction to Materials Engineering and Science for Chemical and Materials Engineers”, John Wiley&Sons, 2004. 3.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	
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	**Applications of Thermoionic and Field Effect Electron Emissions**	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 etc.)	3
11	**Magnetic Materials:** (Diamagnetic, Paramagnetic, Ferromagnetic, Ferrimagnetic and Anti-ferromagnetic Materials, Soft Magnets, Hard Magnets, Superconducting Magnets)	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

	Student Outcomes	Level of Contribution		
		1	2	3
1	an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering science and mathematics			X
2	an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety and welfare as well as global, cultural, social, environmental and economic factors	X		
3	an ability to communicate effectively with a range of audiences	X		
4	an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental and societal contexts	X		
5	an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives	X		
6	an ability to develop and conduct appropriate experimentation, analyse and interpret data, and use engineering judgement to draw conclusions		X	
7	an ability to acquire and apply new knowledge as needed, using appropriate learning strategies			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 AND GLASS			X
	POLYMER	X		
	COMPOSITES	X		
	BIOMATERIALS	X		

1: Little, 2: Partial, 3: Full

Prepared by	**Date**	**Revision #**	**Signature**
Prof. Dr. Kürşat Kazmanlı	December 2020		