Course Name						
SEMICONDUCTOR MATERIALS						
Code	**Semester**	**Local Credits**	**ECTS Credits**	**Course Implementation, Hours/Week**		
				Theoretical	**Tutorial**	**Laboratory**
MET 457E	7	2	3	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**
	-	60	40	-

Course Description	Overview of trends in microelectronic materials and fabrication, Introduction to electronic materials, Energy Bands and Charge carriers, Semiconducting materials, Processing of Integrated Circuits, Lithography, Physical vapor deposition, Chemical vapor deposition, Etching processes, Epitaxial growth, Packaging materials, Solar Cells, Optoelectronic Devices, Superconductors.
Course Objectives	11. To provide knowledge of advanced electronic properties of materials and manufacturing processes in microelectronic devices. 2. To learn silicon integrated circuit (IC) technology and microfabrication techniques 3. To learn nanotechnology applications based on semiconductor materials.
Course Learning Outcomes	Students who pass the course will be able to: 1. Understand electronic band structure of materials 2. Understand the relations between bonding types, crystal structures, defects and electronic properties of materials 3. Understand Quantum Mechanics/Schrödinger wave equation 4. Understand the role of defects in the electrical properties of materials 5. Determine electrical conduction of metals and semiconductors 6. Have a basic knowledge of the processing steps in Semiconductor and microelectronic fabrication techniques 7. Have a basic knowledge on superconductivity, solar cells, optoelectronic devices
Textbook	Solid State Electronic Devices, B. G Streetman and S. Banerjee, ISBN-13: 9780131497269, (Prentice Hall, 6th Ed., 2006).
Other References	1. Electronic Properties of Engineering Materials, by James D. Livingston, ISBN-13: 978-0471316275 (Wiley, 1999) 2. Electronic Materials Science: For Integrated Circuits in Si and GaAs, by J. W. Mayer & S. S. Lau, ISBN-13: 978-0023781407, (MacMillan, 1990) 3. An Introduction to the Physics of Semiconductor Devices, by David J. Roulston, ISBN 13: 978-0195114775, (Oxford University Press, 1998). 4. Fundamentals of Microfabrication, Marc J. Madou, ISBN-13: 978-0849308260, (CRC Press, 2002) 5. Silicon Processing for the VLSI Era, Vol. 1 - Process Technology, by S. Wolf and R. N. Tauber, ISBN-13: 978-0961672164, (Lattice Press, 2nd. Ed. 1999).
Homework & Projects	All homework problems are to be handed in a week after they are assigned. Homework problems may be used as a source for exams.
Laboratory Work	-
Computer Use	-
Other Activities	-

Assessment Criteria	**Activities**	**Quantity**	**Effects on Grading, %**
	Midterm Exams	**1**	**35**
	Quizzes		
	Homework	**6**	**25**
	Projects		
	Term Paper/Project		
	Laboratory Work		
	Other Activities		
	Final Exam	**1**	**40**

COURSE PLAN

Weeks	Topics	Course Outcomes
1	Overview of trends in microelectronic materials and fabrication	1
2	Introduction to electronic materials	1,2
3	Quantum Mechanics/Schrödinger wave equation	3
4	Energy Bands and Charge carriers	3,4
5	Semiconducting materials	4
6	Introduction to microelectronic devices	5
7	Processing of Integrated Circuits	5,6
8	Lithography	6
9	Thin film deposition Techniques: Physical vapor deposition	6
10	Chemical vapor deposition	6
11	Etching processes	6
12	Epitaxial growth	6
13	Packaging materials	6
14	Solar Cells, Optoelectronic Devices and Superconductivity	7

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			

1: Little, 2: Partial, 3: Full

Prepared by	**Date**	**Revision #**	**Signature**
Prof. Dr. Hüseyin Kızıl	December 2020		