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	1. 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	• Electronic Properties of Engineering Materials, by James D. Livingston, ISBN-13: 978-0471316275 (Wiley, 1999) • Electronic Materials Science: For Integrated Circuits in Si and GaAs, by J. W. Mayer & S. S. Lau, ISBN-13: 978-0023781407, (MacMillan, 1990) • An Introduction to the Physics of Semiconductor Devices, by David J. Roulston, ISBN-13: 978-0195114775, (Oxford University Press, 1998). • Fundamentals of Microfabrication, Marc J. Madou, ISBN-13: 978-0849308260, (CRC Press, 2002) • 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	I
2	Introduction to electronic materials	I-II
3	Quantum Mechanics/Schrödinger wave equation	III
4	Energy Bands and Charge carriers	III-IV
5	Semiconducting materials	IV
6	Introduction to microelectronic devices	V
7	Processing of Integrated Circuits	V-VI
8	Lithography	VI
9	Thin film deposition Techniques: Physical vapor deposition	VI
10	Chemical vapor deposition	VI
11	Etching processes	VI
12	Epitaxial growth	VI
13	Packaging materials	VI
14	Solar Cells, Optoelectronic Devices and Superconductivity	VII

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	**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. Hüseyin Kızıl	December 2020	