ABDULLAH GÜL UNIVERSITY
GRADUATE SCHOOL OF ENGINEERING & SCIENCE
ELECTRICAL AND COMPUTER ENGINEERING PROGRAM
COURSE DESCRIPTION AND SYLLABUS

Course Title	Code	Semester	T+L Hours	Credit	ECTS
SEMICONDUCTOR PROCESS AND DEVICE FABRICATION	ECE-686	FALL-SPRING	3 + 0	3	7,5

Prerequisite Courses	None

Type	Selective
Language	English
Coordinator	Assist. Prof. Dooyoung Hah
Instructor	Assist. Prof. Dooyoung Hah
Adjunt	none
Aim	Detailed coverage of microfabrication process technologies for various devices including CMOS and MEMS devices, and modeling of individual processes. Gaining design experience of unit processes and process integration.
Learning Outcomes	To provide an opportunity for students to • learn the scientific principles and technological development in lithography process • learn the scientific principles, technological development, and theoretical modeling of thermal oxidation process • learn the scientific principles, technological development, and theoretical modeling of impurity doping processes • learn the scientific principles, technological development, and theoretical modeling of thin film deposition processes • learn the scientific principles and technological development in etching processes • learn the scientific principles and technological development in micromachining processes • learn the methodology of process integration design
Course Content	• Review of semiconductor materials, • CMOS fabrication process flow, • Review of semiconductor crystal structures and wafer growth, • Photolithography processes, • Thermal oxidation processes of silicon, • Diffusion processes and ion implatation processes, • Thin film deposition processes, • Wet and dry etching processes, Bulk micromachining and surface micromachining processes

WEEKLY TOPICS AND PRELIMINARY STUDY

Week	Topic	Preliminary Study
1	Introduction to microfabrication: Historical background, cleanroom, integrated circuits, technology development trend, review of semiconductor materials	The relevant articles from the literature
2	CMOS fabrication process flow: CMOS process flow details from wafer preparation to back-end processes, design of process integration	The relevant articles from the literature
3	Semiconductor crystal structures and wafer growth: Crystal structure, diamond lattice, Czochralski growth, float-zone method, electrical and physical measurements of wafer characteristics	The relevant articles from the literature
4	Photolithography processes: Exposure systems, light sources, effects of lightwave properties to photolithography processes, properties of photoresists	The relevant articles from the literature
5	Photolithography processes: Advanced photolithography, optical proximity correction, phase shift masks, immersion lithography, double patterning, x-ray lithography, e-beam lithography	The relevant articles from the literature
6	Thermal oxidation of silicon: Basic properties of silicon dioxide, modeling of thermal oxidation, doping effects, measurement methods, high k dielectric materials	The relevant articles from the literature
7	Dopant diffusion: Atomic diffusion mechanisms, diffusion model, two-step diffusion processes, extrinsic diffusion, design of diffused resistors	The relevant articles from the literature
8	Midterm exam	The relevant articles from the literature
9	Ion implantation: Ion implanter, stopping mechanisms, impurity profile, asymmetry in profiles, implantation masking, implantation damage, channeling effects	The relevant articles from the literature

10	Thin film deposition: Material consideration, chemical vaport deposition (CVD) processes, atmospheric pressure CVD, low pressure CVD, plasma-enhanced CVD	The relevant articles from the literature
11	Thin film deposition: Physical vapor deposition processes, thermal evaporation, e-beam evaporation, DC sputtering, RF sputtering, metal interconnect formation	The relevant articles from the literature
12	Etching processes: Selectivity and anisotrophy, etch process control, wet etching	The relevant articles from the literature
13	Etching processes: Plasma etching mechanisms – chemical and physical, ion-enhanced etching, loading effect	The relevant articles from the literature
14	Student presentation: study of advanced topics in semiconductor fabrication processes and presentations by students	The relevant articles from the literature
15	Micromachining: bulk micromachining, crystal-orientation-dependent etching, etch stops, deep reactive ion etch, surface micromachining, stiction prevention, wafer bonding methods	The relevant articles from the literature
16	Final Exam	

SOURCES	
Lecture Notes	Lecture slides
Other Sources	**Course Textbook:** "Silicon VLSI Technology – Fundamentals, Practice and Modeling," J. Plummer, M. Deal, and P. Griffin, 2000, Prentice Hall. **Additional Materials:**

COURSE MATERIALS SHARING	
Documents	Lecture notes and slides
Homeworks	Students will be given one homework in every two weeks
Exams	1 Midterm and 1 Final Exam

EVALUATION SYSTEM		
SEMESTER STUDY	**NUMBER**	**CONTRIBUTION**
Midterm	1	35
Homework	8	10
Semester project	1	20
SUB-TOTAL		65
Contribution of Semester Study		65
Contribution of Final Exam	1	35
TOTAL		100

Course Category	
Sciences and Mathematics	20%
Engineering	80%
Social Sciences	0%

RELATIONSHIPS BETWEEN LEARNING OUTCOMES AND PROGRAM QUALIFICATIONS							
No	Program Qualifications	Contribution Level				
		1	2	3	4	5
1	The skills of using mathematics, science and engineering information in advanced research					**X**
2	The skills of analyzing, designing and/or implementing an original system that will be able to solve an engineering problem					**X**
3	The skills of using the required software, hardware and modern measurement equipments in their field of research					**X**
4	The skills of planning independent research and implementing in detail					**X**
5	The skills of following literature, listening to and making technical presentation, writing a paper in academic level					**X**

6	The skills of innovative and interrogative thinking and finding original solutions					**x**

*Increasing from 1 to 5.

ECTS / WORK LOAD TABLE			
Activities	Number	Duration (Hours)	Total Work Load
Course Length (includes exam weeks: 16x total course hours)	16	3	48
Out-of-class Study Time (Pre-study, practice)	16	2	32
Internet search, library work, literature search	16	2	32
Presentation	1	20	20
Homework	8	3	24
Midterm	1	34	34
Final Exam	1	35	35
Total Work Load			225
Total Work Load / 30			225/30
Course ECTS Credit			7.5