Subject Description Form

Subject Code	EIE560
Subject Title	Microelectronics Processing and Technologies
Credit Value	3
Level	5
Pre-requisite/ Co-requisite/ Exclusion	Students are expected to have some basic knowledge in semiconductor technology and electronic material science. Extra reference materials will be provided for self-learning for those who do not have the appropriate knowledge. Please contact the subject lecturer for details.
Objectives	1. To introduce the basic knowledge of semiconductor microtechnology processing and Internet of Things (IoT) devices. 2. To provide a deep understanding of various thin-film deposition techniques, microfabrication techniques, and materials characterization. 3. To provide students with the knowledge of semiconductor device working mechanism, modern microelectronic device fabrication, device technology for IoT and advanced encapsulation techniques.
Intended Learning Outcomes	Upon completion of the subject, students will be able to: Category A: Professional/academic knowledge and skills a. Understand the fundamental knowledge of semiconductor and microelectronics processing. b. Understand the nature of the deposition process and how it determines the film properties for microelectronic fabrication. c. Be familiar with various thin-film deposition techniques, materials characterization, advanced encapsulation techniques and microfabrication techniques. d. Fundamental hands-on skill sets of thin-film deposition and processing, basic microelectronic/electronic device fabrication for IoT, and device encapsulation. e. Understand the fundamental knowledge of device technology for IoT. Category B: Attributes for all-roundedness f. Think critically and creatively. g. Achieve the ability to technical problems-solving
Subject Synopsis/ Indicative Syllabus	**Syllabus:** 1. Basic Concepts of Semiconductor Microtechnology 1.1 Semiconductors 1.2 The p-n Junction Diodes 1.3 Thin Film Technology 2. Lithography 2.1 Photolithographic Process 2.2 Etching Techniques 2.3 Photomask Fabrication 2.4 Exposure Systems and Sources 2.5 Optical and Electron Microscopy 3. Thermal Oxidation, Diffusion, and Ion Implantation 3.1 The Oxidation Process 3.2 Basic Diffusion Process 3.2.1 Junction Formation and Characterization

3.2.2 Generation-Depth and Impurity Profile Measurement

3.3 Ion Implantation

3.3.1 Implantation Technology

3.3.2 Channelling, Lattice Damage, and Annealing

3.3.3 Implantation-Related Process

4. Film Formation and Deposition

4.1 Evaporation

4.1.1 Kinetic Gas Theory

4.1.2 Filament, Electron-Beam, and Flash Evaporation

4.2 Sputtering

4.3 Chemical Vapor Deposition

4.4 Epitaxy

4.4.1 Vapor-Phase Epitaxy

4.4.2 Doping of Epitaxial Layers

4.4.3 Molecular-Beam Epitaxy

4.5 Materials Characterization and film analysis

4.5.1 Defects

4.5.2 Structure, Composition and Properties

5. Device Technology and Encapsulation for IoT

5.1 Introduction to IoT Devices

5.2 Sensing Technology

5.2.1 Photodiode for Optical Detection

5.2.2 Smart LED Spectrophotometer

5.2.3 Temperature and Strain Sensitive

5.2.4 Health Monitoring

5.3 Advanced Encapsulation

Laboratory Experiment:

1. Thin Film Deposition and Device Fabrication

Teaching/Learning Methodology

Teaching/Learning Methodology	Intended Subject Learning Outcomes						
	a	b	c	d	e	f	g
Lectures	✓	✓	✓		✓		
Tutorials	✓	✓	✓		✓	✓	
Laboratory/experiments	✓	✓	✓	✓	✓	✓	✓

Remarks:

The fundamental knowledge and key principles of the subject will be explained and delivered to students in lectures. Supplementary materials, application and problem examples will be presented and discussed in lectures and tutorials. In laboratory/experiments section, students will be required to design a simple procedure for thin-film deposition/processing and characterization or fabricate a simple functional component of IoT device or conduct a simple device encapsulation. Students are encouraged to solve technical problems and write a lab

<table>
<tr><td></td><td>report, including introduction, experimental details, results, and summary.</td></tr>
<tr><td>Assessment Methods in Alignment with Intended Learning Outcomes</td><td>Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:
<table>
<tr><td rowspan="2">Specific assessment methods/tasks</td><td rowspan="2">% weighting</td><td colspan="7">Intended subject learning outcomes to be assessed (Please tick as appropriate)</td></tr>
<tr><td>a</td><td>b</td><td>c</td><td>d</td><td>e</td><td>f</td><td>g</td></tr>
<tr><td>1. Assignments</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>2. Tests (quizzes and final test)</td><td>30%</td><td>✓</td><td>✓</td><td>✓</td><td></td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>3. Presentation</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>4. Lab report</td><td>20%</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Total</td><td>100%</td><td colspan="7"></td></tr>
</table>
Assignments and Tests: Students will be given assignments, quizzes and final test about the fundamental knowledge and key principles of various thin-film deposition techniques, materials characterization, microfabrication techniques, and device encapsulation. These will assess the knowledge of this subject achieved by the students.
Presentation & Lab report: Students are required to give a course presentation, do experiments, and write lab reports. These will check students' critical thinking skills, hands-on skills and technical problem-solving skills.</td></tr>
<tr><td>Student Study Effort Expected</td><td>
<table>
<tr><td>Class contact:</td><td></td></tr>
<tr><td>▪ Lectures/Tutorials</td><td>27 Hrs.</td></tr>
<tr><td>▪ Assignments and Tests</td><td>3 Hrs.</td></tr>
<tr><td>▪ Laboratory/experiments</td><td>9 Hrs.</td></tr>
<tr><td>Other student study effort:</td><td></td></tr>
<tr><td>▪ Self-study</td><td>50 Hrs.</td></tr>
<tr><td>▪ Lab report writing and Presentation</td><td>20 Hrs.</td></tr>
<tr><td>Total student study effort</td><td>109 Hrs.</td></tr>
</table></td></tr>
<tr><td>Reading List and References</td><td>1. S.M. Sze; M.K. Lee, Semiconductor devices: physics and technology, 3rd edition, 2012.
2. Morgan, D. V.; K Board, An introduction to semiconductor microtechnology, 2nd edition, 1990.
3. Yasuura, Hiroto, et.al., Smart Sensors at the IoT Frontier, 2017.
4. Jaeger, Richard C., Introduction to microelectronic fabrication, 2nd edition, 2002.
5. Smith, Donald L., Thin-film deposition: principles and practice, 1995.
6. Peter M Martin, Handbook of deposition technologies for films and coatings: science, applications, and technology, 3rd edition, 2010.</td></tr>
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