## **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 of 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	<ol> <li>To introduce the basic knowledge of semiconductor microtechnology processing and Internet of Things (IoT) devices.</li> <li>To provide a deep understanding of various thin-film deposition techniques, microfabrication techniques, and materials characterization.</li> <li>To provide students with the knowledge of semiconductor device working mechanism, modern microelectronic device fabrication, device technology for IoT and advanced encapsulation techniques.</li> </ol>
Intended Learning Outcomes	<ul> <li>Upon completion of the subject, students will be able to: <u>Category A: Professional/academic knowledge and skills</u></li> <li>a. Understand the fundamental knowledge of semiconductor and microelectronics processing.</li> <li>b. Understand the nature of the deposition process and how it determines the film properties for microelectronic fabrication.</li> <li>c. Be familiar with various thin-film deposition techniques, materials characterization, advanced encapsulation techniques and microfabrication techniques.</li> <li>d. Fundamental hands-on skill sets of thin-film deposition and processing, basic microelectronic/electronic device fabrication for IoT, and device encapsulation.</li> <li>e. Understand the fundamental knowledge of device technology for IoT.</li> <li><u>Category B: Attributes for all-roundedness</u></li> <li>f. Think critically and creatively.</li> <li>g. Achieve the ability to technical problems-solving</li> </ul>
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

3.3 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         4.1.1 Vapor-Phase Epitaxy         4.4.2 Doping of Epitaxial Layers         4.4.3 Molecular-Beam Epitaxy         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 Structure, Composition and Device Fabrication         5.2.3 Temperature and Strain Sensitive         5.2.4 Health Monitoring         5.3 Advanced Encapsulation         Taboratory Experiment:         1. Thin Film Deposition and Device Fabrication         Taboratory Experiments         2.3 Temperature and Strain Sensitive         5.2.3 Health Monitoring         5.3 Advanced Encapsulation         Taboratory Experiments         1. Thin F		3.2.2 Generation-Dep	oth and	l Impu	rity Pro	ofile M	[easure	ement				
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		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												

	report, including background and Q&A.	d & introduc	tion, di	scussion	n & res	sults, su	mmary	& pers	spective,	
Assessment Methods in Alignment with	Explanation of the appropriateness of the assessment methods in assessing the intended learning outcomes:									
Intended Learning Outcomes	Specific assessment methods/tasks	% weighting	Intended subject learning outcomes to be assessed (Please tick as appropriate)							
			а	b	c	d	e	f	g	
	1. Assignments	20%	✓	✓	~		✓	~		
	2. Tests and Quizzes	20%	~	✓	~		~	✓		
	3. Lab report	30%	~	✓	~	✓	~	✓	✓	
	4. Final Exam	30%	~	✓	~		✓	~	✓	
	Total	100%					1			
Student Study Effort Expected	Class contact:      Lectures/Tutorials      27 Hrs									
	<ul> <li>Assignments and Tests</li> </ul>							3 Hrs.		
	<ul> <li>Laboratory/experiments</li> </ul>						9 Hrs.			
	Other student study effort:									
	<ul> <li>Self-study</li> </ul>						50 Hrs.			
	<ul> <li>Lab report writing</li> </ul>						20 Hrs.			
	Total student study effort						109 Hrs.			
Reading List and References	<ol> <li>S.M. Sze; M.K. Lee, Semiconductor devices: physics and technology, 3<sup>rd</sup> edition, 20</li> <li>Morgan, D. V.; K Board, An introduction to semiconductor microtechnology, 2nd et 1990.</li> <li>Yasuura, Hiroto, et.al., Smart Sensors at the IoT Frontier, 2017.</li> <li>Jaeger, Richard C., Introduction to microelectronic fabrication, 2<sup>nd</sup> edition, 2002.</li> <li>Smith, Donald L., Thin-film deposition: principles and practice, 1995.</li> </ol>									
	<ol> <li>Peter M Martin, Handbook of deposition technologies for films and coatings: science, applications, and technology, 3<sup>rd</sup> edition, 2010.</li> </ol>									