

## ICGEE Curriculum available for 2011/2012 Academic Year

### Semiconductor Processing I

<b>Module Title:</b>	PH5098 - Semiconductor Processing I
<b>Module Status<sup>1</sup>:</b>	Available in first semester 2011/2012 academic year, starting from September 2011

#### Generic Module Information

Name of module owner/lecturer?	Dr. Arousian Arshak & Prof. Khalil Arshak
Delivery mode: e.g. on-site, on-line, mixed-mode, intensive block delivery. For on-site specify contact hours per week	<p><b>For Limerick located students:</b> on-site in UL: 2 hours lectures per week, 2 hours of laboratory per week and 1 hour of tutorial per week.</p> <p><b>For students from other locations:</b> Intensive block delivery mode, 1 week (<b>from November 28th, 2011 to December 1st, 2011</b>) on-site in UL plus course materials available online via ICGEE VLE.</p>
Duration of the module:	1 semester
Assessment methods and weightings where relevant:	20% project 80% written exam
Pass standard:	30%
Penalties for late submission of continuous assessment work:	None
Number of ECTs or institutional credits assigned to the module:	6 ECTs
Course Content or Syllabus	<p><b>Rational</b></p> <ul style="list-style-type: none"> <li>The purpose of this module is to introduce students to the fundamentals of semiconductor process technology focusing on silicon technology and integrated circuit processes</li> </ul> <p><b>Syllabus</b></p> <ul style="list-style-type: none"> <li>Semiconductor technology: overview of advances in integrated circuits, the road map, Moore's law.</li> <li>General nature of semiconductor materials: elemental materials and their uses in research and industry, compound materials and alloys and their applications, influence of purity on electrical properties of semiconductors. Structure of semiconductors: amorphous, crystalline and polycrystalline solids, unit cells, lattice types, body centered cubic, face centered cubic, the diamond lattice, Si and Ge, Miller indices.</li> <li>Electrical properties: contribution of mobility and free carrier density to resistivity, electrical properties of conductors, semiconductors and insulators.</li> <li>Semiconductors: pure semiconductors, important elements from group 3, group 4 and group 5 of the periodic table,</li> </ul>

<sup>1</sup> Is the module available, what is the planned start date?

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	<p>valence electrons, covalent bonding, p-type semiconductors and n-type semiconductors, energy levels for p-type and n-type semiconductors, intrinsic energy level, intrinsic carrier density, thermal equilibrium, carrier lifetime.</p> <ul style="list-style-type: none"> <li>• Doping of silicon: donors and acceptors, majority carriers and minority carriers, hot point probe, 4-point probe sheet resistance, carrier transport. Lithography: lithography processes (light sources, exposure systems, photoresist), aerial image, latent image, relief image, pattern definition, pattern transfer (etching, deposition, implantation etc.).</li> <li>• Optical lithography techniques: optical resists, key resist parameters, positive and negative resist, DNQ system and deep UV system. Resist processing: priming, spinning, baking, exposing, developing, hard baking, stripping. Exposure: types of exposure (UV light to deep UV, X-rays, electrons, ions), method of exposure, development (positive, negative).</li> <li>• Printing: Fresnel system, contact and proximity printing, Fraunhofer system, projection printing, advantages and disadvantages.</li> <li>• Advanced lithography: focused ion beam, electron beam, etc. Thermal oxidation of silicon: the oxidation process, type of furnaces, wet oxidation, dry oxidation, factors influencing oxidation rates, silica film thickness measurements. Thin film deposition: evaporation, sputtering, chemical vapour deposition. Diffusion: diffusion processes, constant source diffusion, limited source diffusion, solid solubility limits.</li> <li>• Epitaxial silicon deposition: LPCVD amorphous silicon, importance of epitaxy.</li> <li>• Ion implantation: implantation technology, channelling, lattice damage and annealing.</li> </ul>
Learning Outcomes	<p><b><i>Cognitive (Knowledge, Understanding, Application, Analysis, Evaluation, Synthesis)</i></b></p> <ul style="list-style-type: none"> <li>• Define key concepts relating to structure, properties, diffusion and ion implantation in silicon.</li> <li>• Explain the physical concepts underlying semiconductor process technology.</li> <li>• Discuss the principles of lithography in relation to silicon technology and integrated circuit processes.</li> <li>• Derive relevant equations describing semiconductor process technology, from basic laws and principles.</li> <li>• Solve numerical problems from information provided on the topics covered.</li> </ul> <p><b><i>Affective (Attitudes and Values)</i></b></p> <ul style="list-style-type: none"> <li>• Discuss the importance of silicon technology and integrated circuit processes in applied physics.</li> </ul> <p><b><i>Psychomotor (Physical Skills)</i></b></p> <ul style="list-style-type: none"> <li>• Perform experiments requiring precise measurement. Use mechanical, optical and electronic apparatus for observation and measurement.</li> </ul>
Recommended Text	<ul style="list-style-type: none"> <li>• S. M Sze, (1988) VLSI Technology , McGraw-Hill</li> <li>• David J. Elliott (1992) Integrated Circuit Fabrication Technology , McGraw-Hill</li> <li>• Dieter K. Schroder (1987) ADVanced MOS Devices , Addison-Wesley</li> </ul>
Supplementary Texts	none