# Global Learning Initiatives Program Course Syllabus

**Course Information**

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| Course Name | Semiconductor Physics and Devices (I) |
| Lecturer(s) | Tian-Li Wu |
| Course Description | Semiconductor technologies become the necessary to enable high performance electronic products. Recently, the demanding of the new applications, such as 5G, AI, cloud computing, and Electric vehicle, trigger the innovations of the semiconductor technologies. The core knowledge for the state-of-the-art semiconductor technologies is the Semiconductor Physics and Devices, which is essential for every researchers and engineers. In this class, the properties for the semiconductor materials, the physics of the carrier drift, and the operation principals for the most important devices architectures, i.e., Diode, BJT, MOSFET, and JFET, will be introduced and discussed in details. Furthermore, the recent progress and challenges in developing beyond Moore's law technologies will be reviewed. |
| Course Objectives | Intended Learning Outcomes (ILOs):<br>By the end of this class, you should be able to:<br>1. Explain the basic materiel properties and device physics.<br>2. Apply the device physics to evaluate the operation principles of p-n diodes, MOSFETs, BJTs, and JFETs.<br>3. Evaluate the current issues in the scaling technologies (More Moore technologies), e.g., short channel effects, ultra-thin dielectric, subthreshold swing (SS), etc.<br>4. Propose the designs to overcome the challenges in the scaling semiconductor technologies. |
| Suggested Proficiencies (if any) | 1. Graduate students/ undergraduate students who have knowledge in basic physics.<br>2. Passion in semiconductor technologies |

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| Reading List<br>(if any) | 1. D. Neamen, Semiconductor Physics And Devices, 4th edition (2012)<br>2. Lecture notes |
| Grading Criteria | Exam 50%<br>Homework 35%,<br>Class participation 15% |

**Course Schedule**

| Class | Date (YYYY/MM/DD) | Course Topic | Lecturer |
|---|---|---|---|
| 1 | 2021/2/22 | Introduction | Tian-Li Wu |
| 2 | 2021/3/01 | Holiday | Tian-Li Wu |
| 3 | 2021/3/08 | The Crystal Structure of Solids | Tian-Li Wu |
| 4 | 2021/3/15 | Introduction to Quantum Mechanics and Quantum Theory of Solids | Tian-Li Wu |
| 5 | 2021/3/22 | The Semiconductor in Equilibrium & Carrier Transport | Tian-Li Wu |
| 6 | 2021/3/29 | The Semiconductor in Equilibrium & Carrier Transport | Tian-Li Wu |
| 7 | 2021/04/05 | Holiday | Tian-Li Wu |
| 8 | 2021/04/12 | Nonequilibrium Excess Carriers in Semiconductors | Tian-Li Wu |
| 9 | 2021/04/19 | The pn Junction | Tian-Li Wu |
| 10 | 2021/05/03 | The pn Junction Diode | Tian-Li Wu |
| 11 | 2021/05/10 | The Bipolar Transistor | Tian-Li Wu |
| 12 | 2021/05/17 | The Bipolar Transistor | Tian-Li Wu |
| 13 | 2021/05/24 | Metal-Oxide-Semiconductor Field-Effect Transistor | Tian-Li Wu |
| 14 | 2021/05/31 | Metal-Oxide-Semiconductor Field-Effect Transistor/ Junction Field-Effect Transistor | Tian-Li Wu |

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| 15 | 2021/06/07 | Final exam | Tian-Li Wu |