

國立中正大學化工所碩士班 114 學年度第一學期教學大綱表

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| 課程名稱：(中文)半導體製程技術導論<br>(英文) Introduction to semiconductor technology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                                                                                                                                                                      |     |   |    | 開課單位 | 工學院     |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                                                                                                                                                                                                      |     |   |    | 課程代碼 | 4015013 |
| 授課教師                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 賴聰升、李元堯                                                                                                                                                                                                                                                                                                                                                              | 學分數 | 3 | 選修 | 開課年級 | 碩博合開    |
| 全英文授課<br>EMI                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <input type="checkbox"/> 是 <input checked="" type="checkbox"/> 否                                                                                                                                                                                                                                                                                                     |     |   |    |      |         |
| 先修科目或先備能力：                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                      |     |   |    |      |         |
| 課程概述：<br>本課程將介紹半導體元件的製程原理和技術。在本課程中，將詳細介紹積體電路之發展和製程的介紹。由於商業用電子元件(包含手機、車用晶片、軍事用電子元件)的大量需求，加上全球電腦和網絡建設的推進以及普及，半導體產業之發展也隨時代的推演而更加蓬勃。其中，半導體之製程更是這些元件的發展基礎。為此，本課程將提供學生針對半導體元件製程技術的相關元件設計之知識以及必備的製程技術。此外，學生將在學期末進行口頭報告。<br>This course will introduce the process principles and technologies of semiconductor components. In this course, the development and process of integrated circuits will be introduced in detail. Due to the large demand for commercial electronic components (including mobile phones, automotive chips, and military electronic components), coupled with the promotion and popularization of global computer and network construction, the development of the semiconductor industry has also become more vigorous with the deduction of the times. Among them, the semiconductor manufacturing process is the basis for the development of these components. To this end, this course will provide students with the knowledge of related component design and necessary process technology for semiconductor component process technology. In addition, students will give an oral presentation at the end of the semester. |                                                                                                                                                                                                                                                                                                                                                                      |     |   |    |      |         |
| 目標：<br>學生將學習半導體元件的製程原理和技術以及半導體產業及相關材料的發展，包括元件製程、遮罩、蝕刻技術以及電晶體等電子元件的工作機制。<br>Students will learn the process principles and technologies of semiconductor components and the development of semiconductor industry and related materials, including component process, masking, etching technology and the working mechanism of electronic components such as transistors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                      |     |   |    |      |         |
| 教科書                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Introduction to semiconductor technology / Hong Xiao. – 2nd ed.、自製教材                                                                                                                                                                                                                                                                                                 |     |   |    |      |         |
| 教學要點概述                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                      |     |   |    |      |         |
| 教材編選<br>teaching<br>materials                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <input checked="" type="checkbox"/> 自製簡報(ppt) <input checked="" type="checkbox"/> 課程講義 <input type="checkbox"/> 自編教科書<br><input type="checkbox"/> 教學程式 <input checked="" type="checkbox"/> 自製教學影片 <input checked="" type="checkbox"/> 其他                                                                                                                             |     |   |    |      |         |
| 教學方法<br>teaching<br>methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <input checked="" type="checkbox"/> 講述 <input checked="" type="checkbox"/> 小組討論 <input type="checkbox"/> 學生口頭報告 <input checked="" type="checkbox"/> 問題導向學習<br><input checked="" type="checkbox"/> 個案研究 <input type="checkbox"/> 其他                                                                                                                                   |     |   |    |      |         |
| 評量工具<br>Evaluation<br>tools                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <input checked="" type="checkbox"/> 期中考 <input checked="" type="checkbox"/> 期末考 <input checked="" type="checkbox"/> 隨堂測驗 <input checked="" type="checkbox"/> 隨堂作業<br><input type="checkbox"/> 課後作業 <input type="checkbox"/> 期中報告 <input type="checkbox"/> 期末報告 <input type="checkbox"/> 專題報告<br><input checked="" type="checkbox"/> 評量尺規 <input type="checkbox"/> 其他 |     |   |    |      |         |

| 教學資源<br>teaching<br>resources                           | <input checked="" type="checkbox"/> 課程網站 <input type="checkbox"/> 教材電子檔供下載 <input type="checkbox"/> 實習網站                                                           |      |    |    |    |                        |
|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|----|----|----|------------------------|
| 教師相關訊息<br>instructor's<br>information                   |                                                                                                                                                                    |      |    |    |    |                        |
| 課程大綱                                                    |                                                                                                                                                                    | 分配時數 |    |    |    | 可達成核心能力                |
| 單元主題                                                    | 內容綱要                                                                                                                                                               | 講授   | 示範 | 習作 | 其它 |                        |
| Introduction of optoelectronics semiconductor           | 1. Brief History of Integrated Circuits<br>2. Brief Overview of Integrated Circuits                                                                                | 3    |    | 1  | 1  | D1, D2, D3, D4,D5, D6, |
| Introduction to Integrated Circuit Fabrication          | 1. Introduction & Yield<br>2. Cleanroom Basics<br>3. Basic Structure of an Integrated Circuit Fabrication Facility<br>4. Testing and Packaging<br>5. Future Trends | 3    |    | 1  | 1  | D1, D2, D3, D4,D5, D6, |
| Semiconductor Basics                                    | 1. What Is a Semiconductor?<br>2. Bandgap<br>3. Crystal structure<br>4. Doping semiconductor<br>5. Dopant concentration and conductivity                           | 3    |    | 1  | 1  | D1, D2, D3, D4,D5, D6, |
| Wafer Manufacturing, Epitaxy, and Substrate Engineering | 1. Why Silicon?<br>2. Crystal Structures and Defects<br>3. Sand to Wafer<br>4. Epitaxial Silicon Deposition<br>5. Substrate Engineering                            | 3    |    | 1  | 1  | D1, D2, D3, D4,D5, D6, |
| Thermal Processes                                       | 1. Thermal Process Hardware<br>2. Oxidation<br>3. Diffusion<br>4. Annealing<br>5. High-Temperature Chemical Vapor Deposition<br>6. Rapid Thermal Processing        | 3    |    | 1  | 1  | D1, D2, D3, D4,D5, D6, |
| Photolithography                                        | 1. Photoresist<br>2. Photolithography Process<br>3. Lithographic Technology Trends                                                                                 | 3    |    | 1  | 1  | D1, D2, D3, D4,D5, D6, |
| Plasma Basics                                           | 1. Definition of Plasma<br>2. Collisions in Plasma<br>3. Plasma Parameters<br>4. Ion Bombardment<br>5. Direct-Current Bias<br>6. Advantage of Plasma Processes     | 3    |    | 1  | 1  | D1, D2, D3, D4,D5, D6, |
| Ion Implantation                                        | 1. Ion Implantation Basics<br>2. Ion Implantation Hardware<br>3. Ion Implantation Process                                                                          | 3    |    | 1  | 1  | D1, D2, D3, D4,D5, D6, |

|                                                     |                                                                                                                                                                                |                            |  |   |   |                        |
|-----------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--|---|---|------------------------|
| Etch                                                | 1. Etch Basics<br>2. Wet Etch Process<br>3. Plasma (Dry) Etch<br>4. Plasma Etch Processes                                                                                      | 6                          |  | 1 | 1 | D1, D2, D3, D4,D5, D6, |
| Chemical Vapor Deposition and Dielectric Thin Films | 1. Chemical Vapor Deposition<br>2. Chemical vapor deposition reactor types<br>3. Chemical vapor deposition basics                                                              | 6                          |  | 1 | 1 | D1, D2, D3, D4,D5, D6, |
| Metallization                                       | 1. Conducting Thin Films<br>2. Metal Thin-Film Characteristics<br>3. Metal Chemical Vapor Deposition<br>4. Physical Vapor Deposition                                           | 3                          |  | 1 | 1 | D1, D2, D3, D4,D5, D6, |
| Chemical Mechanical Polishing                       | 1. Chemical Mechanical Polishing Hardwar<br>2. Chemical Mechanical Polishing Slurries<br>3. Chemical Mechanical Polishing Basics<br>4. Chemical Mechanical Polishing Processes | 3                          |  | 1 | 1 | D1, D2, D3, D4,D5, D6, |
| Process Integration                                 | 1. Wafer Preparation<br>2. Isolations<br>3. Well Formation<br>4. Transistor Formation<br>5. Metal-Oxide-Semiconductor Field-Effect Transistors with High-k and Metal Gates     | 3                          |  | 1 | 1 | D1, D2, D3, D4,D5, D6, |
| 可達成核心能力                                             |                                                                                                                                                                                | 核心能力達成指標                   |  |   |   |                        |
| D1                                                  | 具有化工領域專業知識及問題解析能力。                                                                                                                                                             | 具化工領域之專業知識。                |  |   |   |                        |
| D2                                                  | 具備研究規劃、計畫執行、儀器分析、數據處理之能力。                                                                                                                                                      | 具備研究規劃、計畫執行、儀器分析、數據處理之能力。  |  |   |   |                        |
| D3                                                  | 熟練文獻蒐集，具備書面及口頭報告之能力。                                                                                                                                                           | 熟練文獻蒐集，具備書面及口頭報告之能力。       |  |   |   |                        |
| D4                                                  | 具備獨立思考、創新研發、終身學習以及國際思維之能力。                                                                                                                                                     | 具備獨立思考、創新研發、終身學習以及國際思維之能力。 |  |   |   |                        |
| D5                                                  | 具備領導、溝通與團隊合作之能力。                                                                                                                                                               | 具備領導、溝通與團隊合作之能力。           |  |   |   |                        |
| D6                                                  | 理解專業倫理及社會責任，重視作業安全與環保永續。                                                                                                                                                       | 理解專業倫理及社會責任，重視作業安全與環保永續。   |  |   |   |                        |

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|--------------------|-----------------------|------|--------|
| 教學要點概述：(半導體製程技術導論) |                       |      |        |
| 上課時間               | 週四<br>(下午 3 點-下午 6 點) | 上課地點 | 機械 116 |

|                     |                                                                               |             |                                                                       |
|---------------------|-------------------------------------------------------------------------------|-------------|-----------------------------------------------------------------------|
| 評量方式                | 期中考 40%<br>期末考 40%<br>期末報告 20%<br>「教師得視授課實際狀況，<br>對課程評分標準有保留、修<br>改、變更細節之權利。」 | Office hour | 每週三 14:00~17:00<br>Tel: (05)2720411-23600<br>E-mail: yslai@ccu.edu.tw |
| 週次                  | 教 學 與 作 業 進 度                                                                 |             | 備 註                                                                   |
| 1                   | Introduction                                                                  |             |                                                                       |
| 2                   | Introduction to Integrated Circuit Fabricatio                                 |             |                                                                       |
| 3                   | Semiconductor Basics                                                          |             |                                                                       |
| 4                   | Wafer Manufacturing, Epitaxy, and Substrate Engineering                       |             |                                                                       |
| 5                   | Thermal Processes                                                             |             |                                                                       |
| 6                   | Photolithography                                                              |             |                                                                       |
| 7                   | Plasma Basics                                                                 |             |                                                                       |
| 8                   | Ion Implantation                                                              |             |                                                                       |
| 9                   | Midterm Exam                                                                  |             |                                                                       |
| 10                  | Etch                                                                          |             |                                                                       |
| 11                  | Etch                                                                          |             |                                                                       |
| 12                  | Chemical Vapor Deposition and Dielectric Thin Films                           |             |                                                                       |
| 13                  | Chemical Vapor Deposition and Dielectric Thin Films                           |             |                                                                       |
| 14                  | Metallization                                                                 |             |                                                                       |
| 15                  | Presentation                                                                  |             |                                                                       |
| 16                  | Chemical Mechanical Polishing                                                 |             |                                                                       |
| 17                  | Process Integration                                                           |             |                                                                       |
| 18                  | Final Exam                                                                    |             |                                                                       |
| 其他：教師可視學生理解程度調整上課內容 |                                                                               |             |                                                                       |