



## 教學計劃表 Syllabus

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|--|--|-----------------------------|---------------------------------|---|
| 課程名稱(中文)<br>Course Name in Chinese   | 太陽能電池  |                             | 學年/學期<br>Academic Year/Semester | 113/1   |
| 課程名稱(英文)<br>Course Name in English   | Photovoltaic Devices   |                             |                                 |   |
| 科目代碼<br>Course Code  | EE_M0160   | 系級<br>Department & Year     | 碩士                              | 開課單位<br>Course-Offering Department  |
| 電機工程學系   |  |                             |                                 |   |
| 修別<br>Type   | 選修 Elective  | 學分數/時間<br>Credit(s)/Hour(s) | 3.0/3.0                         |   |
| 授課教師<br>Instructor   | /黃家華   |                             |                                 |   |
| 先修課程<br>Prerequisite   |  |                             |                                 |   |
| 課程描述 Course Description  |  |                             |                                 |   |
| The irradiance of sun light is briefly discussed. The fundamental concepts and operation principles of photovoltaic devices are introduced. The required properties of semiconductor materials for photovoltaic applications are addressed. The technologies of crystalline photovoltaic devices including Si solar cells, and III-V compound solar cells are presented. |  |                             |                                 |   |
| 課程目標 Course Objectives   |  |                             |                                 |   |
| 本課程主要介紹太陽能電池基本概念和工作原理，及介紹可應用於太陽能電池之主要材料和其特性，並說明各類太陽能電池之元件結構及設計原理。  |  |                             |                                 |   |
| 系專業能力<br>Basic Learning Outcomes   |  |                             |                                 | 課程目標與系專業能力相關性<br>Correlation between Course Objectives and Dept.'s Education Objectives |
| A  | 培育具備電機電子資訊工程等專業技術研發之能力。To cultivate the research and developing ability of electrical, electronics and information engineering。  |                             |                                 | ●   |
| B  | 培育系統分析、模擬驗證、實作實現之能力。To cultivate the advanced ability of analysis, verification and implementation of systems。   |                             |                                 | ○   |
| C  | 訓練軟體工具使用與硬體實務驗證相互輔助之能力To train the auxiliary ability between the utilization of software tool and the verification of the hardware practice。   |                             |                                 | ○   |
| D  | 訓練電機電子資訊專業知識與工程實務相互結合運用之能力。To train the integrate ability between professional EECS knowledge and engineering practice   |                             |                                 | ●   |
| E  | 落實論文研究之群體討論與團隊合作之互助能力。To fulfill the research ability in thesis by group discussion and teamwork cooperation   |                             |                                 | ○   |
| F  | 落實發掘問題、邏輯分析、克服瓶頸與持續學習之能力。To fulfill the ability of question finding, logical analyzing, bottleneck overcoming and continuous learning  |                             |                                 | ●   |
| G  | 了解學術倫理與智慧財產觀念，掌握國內外產業更迭需求與具備多元專長之能力。To obtain the ability of multi-specialization and to meet the industry demand as well as to have the ability of academic ethics and concept of intellectual property |                             |                                 | ○   |
| H  | 了解國內外市場變化，具備科技英文閱讀溝通與科技論文寫作之能力。To understand the change of global market and to have the ability of reading, conversation and technical writing in English。  |                             |                                 | ○   |
| 圖示說明Illustration：● 高度相關 Highly correlated ○ 中度相關 Moderately correlated   |  |                             |                                 |   |
| 授課進度表 Teaching Schedule & Content  |  |                             |                                 |   |
| 週次Week   | 內容 Subject/Topics  |                             |                                 | 備註Remarks   |
| 1  | 1. Introduction of course contents<br>2. Introduction of photovoltaics   |                             |                                 |   |

|    |   |  |
|----|---|--|
| 2  | Fundamentals of semiconductors:<br>1. Intrinsic and extrinsic semiconductors<br>2. Doping<br>3. Semiconductor statistics  |  |
| 3  | Fundamentals of semiconductors:<br>4. Degenerate and nondegenerate semiconductors<br>5. Direct and indirect bandgap semiconductors  |  |
| 4  | Junction theory:<br>1. Formation of pn junction<br>2. Band diagram of pn junction<br>3. Heterojunction  |  |
| 5  | 1. Interaction between light and semiconductors<br>2. Emission and absorption of photons<br>3. Absorption coefficients and penetration depth<br>4. Thickness of solar cells   |  |
| 6  | 1. Fundamentals of photovoltaics<br>2. Solar spectrum<br>3. Standard reporting conditions and measurements<br>4. IV characteristics<br>5. Performance of photovoltaic devices |  |
| 7  | Exam 1  |  |
| 8  | Operation principles of pn-junction photovoltaic devices  |  |
| 9  | Required properties of photovoltaic materials<br>Classification of photovoltaic materials   |  |
| 10 | Development trends and current status of photovoltaics  |  |
| 11 | Classification of solar cells:<br>1. Wafer-based solar cells<br>2. Thin-film solar cells  |  |
| 12 | Fundamentals of crystalline Si solar cells  |  |
| 13 | Exam 2  |  |
| 14 | High-efficiency crystalline Si solar cells  |  |
| 15 | 1. III-V solar cells<br>2. Multi-junction solar cells<br>3. Concentrator photovoltaics  |  |
| 16 | Introduction of thin-film solar cells   |  |
| 17 | Oral presentations  |  |
| 18 | Flexible solar cells  |  |

教學策略 Teaching Strategies

- 課堂講授 Lecture       分組討論 Group Discussion       參觀實習 Field Trip  
 其他 Miscellaneous:

教學創新自評 Teaching Self-Evaluation

創新教學 (Innovative Teaching)

- 問題導向學習 (PBL)       團體合作學習 (TBL)       解決導向學習 (SBL)  
 翻轉教室 Flipped Classroom       磨課師 Moocs

社會責任 (Social Responsibility)

- 在地實踐 Community Practice       產學合作 Industry-Academia Cooperation

跨域合作 (Transdisciplinary Projects)

- 跨界教學 Transdisciplinary Teaching       跨院系教學 Inter-collegiate Teaching  
 業師合授 Courses Co-taught with Industry Practitioners

其它 other:

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學期成績計算及多元評量方式 Grading & Assessments

| 配分項目<br>Items  | 配分比例<br>Percentage | 多元評量方式 Assessments |          |          |          |          |          |          |    |
|--|--------------------|--------------------|----------|----------|----------|----------|----------|----------|----|
|  |                    | 測驗<br>會考           | 實作<br>觀察 | 口頭<br>發表 | 專題<br>研究 | 創作<br>展演 | 卷宗<br>評量 | 證照<br>檢定 | 其他 |
| 平時成績 General<br>Performance                                |                    |                    |          |          |          |          |          |          |    |
| 期中考成績 Midterm Exam   | 40%                | ✓                  |          |          |          |          |          |          |    |
| 期末考成績 Final Exam   | 40%                | ✓                  |          |          |          |          |          |          |    |
| 作業成績 Homework and/or<br>Assignments                        |                    |                    |          |          |          |          |          |          |    |
| 其他 Miscellaneous<br>(oral presentation and<br>term papers) | 20%                |                    |          | ✓        | ✓        |          |          |          |    |

評量方式補充說明

Grading & Assessments Supplemental instructions

教科書與參考書目 (書名、作者、書局、代理商、說明)

Textbook & Other References (Title, Author, Publisher, Agents, Remarks, etc.)

1. "Handbook of Photovoltaic Science and Engineering," John Wiley & Sons.
2. "The Physics of Solar Cells," Jenny Nelson, Imperial College Press.
3. "Photovoltaic Materials," Richard H. Bube, Imperial College Press.

課程教材網址(含線上教學資訊, 教師個人網址請列位於本校內之網址)

Teaching Aids & Teacher's Website(Including online teaching information.

Personal website can be listed here.)

meet.google.com/pue-oprt-kmj

其他補充說明 (Supplemental instructions)