Please consult Intellectual Property Rights before making a photocopy. Please use the textbook of copyrighted edition.

## ②國玄東華大學

## 教學計劃表 Syllabus

	名稱(中文) me in Chinese	太陽能電池			學年/學期 Academic Year/Sem	113/1				
	名稱(英文) me in English	h Photovoltaic Devices								
	-目代碼 rse Code	系級 EED0110 Department 博士 & Year			開課單位 Course-Offering Department	電	機工程學系			
	修別 Type	選修 Elective	0/3.0							
	課教師 structor	/黄家華								
	上修課程 requisite									
		課	程描述 Course	e Descrip	tion					
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 Cours	se Object	ives					
	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									
課程目標與系專業負力相關性										
						Cor	urse Objectives and Dept.'s			
I A	- -備電機電子資訊工利	Basic Lear 程等專業技術研發-	ning Outcomes と能力。To cult			Cor	urse Objectives and Dept.'s Education			
B 培育系 analys	oping ability of 总統分析、模擬驗證 sis, verification	Basic Lear 理等專業技術研發 electrical, ele 、實作實現之能力 and implementati	ning Outcomes 之能力。To cult ectronics and in To cultivate	nformation the advance	engineering。 ed ability of	Con	urse Objectives and Dept.'s Education			
B develor B 培育系 analys	oping ability of 系統分析、模擬驗證 sis, verification 內體工具使用與硬體質	Basic Lear 程等專業技術研發 electrical, ele 、實作實現之能力 and implementati 實務驗證相互輔助	を能力。To cult ectronics and in To cultivate on of systems。 と能力。To train	nformation the advance n the auxi	engineering。 ed ability of liary ability between	Con	urse Objectives and Dept.'s Education			
A develor B 培育系 analys C 訓練軟 the unity	oping ability of 統分析、模擬驗證 sis, verification c體工具使用與硬體的 tilization of soft	Basic Learn  望等專業技術研發- electrical, ele 、實作實現之能力 and implementati 實務驗證相互輔助- ware tool and th 哉與工程實務相互	を能力。To cult ectronics and in o To cultivate on of systems。 と能力。To train e verification 結合運用之能力。	nformation the advance n the auxi of the har	engineering。 ed ability of liary ability between	Con	urse Objectives and Dept.'s Education			
B 培育系 analys C 訓練軟 the under the un	oping ability of s.統分析、模擬驗證 sis, verification c體工具使用與硬體 tilization of soft c機電子資訊專業知 en professional EB 5科技研究之分工整行 research with int	Basic Learn  理等專業技術研發 electrical, ele 、實作實現之能力 and implementati 實務驗證相互輔助 ware tool and th 裁與工程實務相互終 CS knowledge and 今與團體合作之領 egration and tea	を能力。To cult ectronics and in To cultivate on of systems。 と能力。To traine verification は合運用之能力。 は engineering pu 導能力。To fulf amwork cooperat	nformation the advance on the auxi of the har To train ractice o ill the leadion of	engineering ° ed ability of  liary ability between rdware practice ° the integrate ability ading ability in high	Con	urse Objectives and Dept.'s Education			
B develor Handler Han	oping ability of 然分析、模擬驗證 sis, verification 於體工具使用與硬體 tilization of soft 透機電子資訊專業知 en professional EB 所科技研究之分工整 research with int 採掘問題、邏輯分析 ng, logical analyz	Basic Learn  星等專業技術研發 electrical, ele 、實作實現之能力 and implementati 實務驗證相互輔助 ware tool and th 哉與工程實務相互結 CS knowledge and 合與團體合作之領導 egration and tea 、克服瓶頸與持續 ing, bottleneck	を能力。To cult extronics and in To cultivate on of systems。 と能力。To traine verification は合運用之能力。I engineering pup能力。To fulfamwork cooperat 學習之能力。To overcoming and	nformation the advance n the auxi of the har To train ractice o ill the lea ion o fulfill the	engineering ° ed ability of  liary ability between rdware practice ° the integrate ability  ading ability in high e ability of question s learning °	Con	urse Objectives and Dept.'s Education			
B develor separate A develor B analys C all separate A develor B analys C all separate A separate	oping ability of 然分析、模擬驗證 sis, verification 校體工具使用與硬體質 tilization of soft 透機電子資訊專業知識 en professional EF 5科技研究之分工整行 research with int 孫据問題、邏輯分析 ng, logical analyz 是術倫理與智慧財產額 bility of multi-spethe ability of aca	Basic Learn Basic	を能力。To cult extronics and in To cultivate on of systems。 と能力。To train exertification は合運用之能力。Id engineering pu 等能力。To fulf unwork cooperat 學習之能力。To overcoming and 産業更迭需求與具 to meet the ind concept of in	nformation the advance n the auxi of the har To train ractice。 ill the leation。 fulfill the continuous 其備多元專長 ndustry der tellectual	engineering。 ed ability of  liary ability between rdware practice。 the integrate ability ading ability in high e ability of question s learning。 表之能力。To obtain mand as well as to property。	Col	urse Objectives and Dept.'s Education			
A develor B separation A develor B separation A develor B separation A separation A separation A separation B separation A separation B separation A separation B separation A separation B separation	oping ability of 然分析、模擬驗證 sis, verification 機體工具使用與硬體質 tilization of soft 提機電子資訊專業知識 en professional EF 5科技研究之分工整 research with int 孫相問題、邏輯分析 ng, logical analyz 上術倫理與智慧財產制 bility of multi-sp the ability of aca 国際研討會了解國際 cipate the conference cipate the conference 2.	Basic Learn  望等專業技術研發= electrical, ele 文實作實現之能力 and implementati 實務驗證相互輔助= ware tool and th 截與工程實務相互。 CS knowledge and 全與團體合作之領。 egration and tea 文克服瓶頸與持續學 ing, bottleneck  現念,掌握國內外於 ecialization and idemic ethics and 市場變化與未來研究 ences to understa	を能力。To cult extronics and in To cultivate on of systems。 こ能力。To train exertification は合運用之能力。 Id engineering pi 等能力。To fulf amwork cooperat 學習之能力。To overcoming and 産業更迭需求與具 to meet the in concept of in 究走向,具備純熟 and the change	nformation the advance n the auxi of the har To train ractice。 ill the leation。 fulfill the continuous 其備多元專長 ndustry der tellectual	engineering。 ed ability of  liary ability between rdware practice。 the integrate ability  ading ability in high e ability of question s learning。  技之能力。To obtain mand as well as to	Col	urse Objectives and Dept.'s Education			
A develor B develor B develor	oping ability of 然分析、模擬驗證 sis, verification 是體工具使用與硬體 tilization of soft 透機電子資訊專業知識 en professional EE 5种技研究之分工整征 research with int 是個問題、邏輯分析 ng, logical analyz 對价。 對价。 對价。 對价。 對付。 對於一數 一數 一數 一數 一數 一數 一數 一數	Basic Learn  Was a space of the space of the skillful a  Basic Learn	を能力。To cult ectronics and in To cultivate on of systems。 と能力。To train everification 結合運用之能力。To fulf engineering pu 手能力。To fulf engineering and を業更迭ます。To overcoming and を業更迭ます。 To in concept of in 究走向,具備純熟 and the change of ability of read	nformation the advance n the auxi of the har To train ractice。 ill the leadion。 fulfill the continuous 其備多元專長 ndustry der tellectual 热科技英文及 of global n ing, conven	engineering。 ed ability of  liary ability between rdware practice。 the integrate ability ading ability in high e ability of questions learning。 是之能力。To obtain mand as well as to property。  閱讀溝通寫作之能力。To market and the future	Con	urse Objectives and Dept.'s Education Objectives			
A develor B develor B develor	oping ability of 然分析、模擬驗證 sis, verification 是體工具使用與硬體 tilization of soft 透機電子資訊專業知識 en professional EE 5种技研究之分工整征 research with int 是個問題、邏輯分析 ng, logical analyz 對价。 對价。 對价。 對价。 對付。 對於一數 一數 一數 一數 一數 一數 一數 一數	Basic Learn  望等專業技術研發= electrical, ele 文實作實現之能力 and implementati 實務驗證相互輔助= ware tool and th 裁與工程實務相互。 公 knowledge and egration and tea 文 克服瓶頸與持續。 ing, bottleneck 認念, 掌握國內外方。 decialization and demic ethics and respondented to the skillful a  高度相關 Hi	を能力。To cult ectronics and in To cultivate on of systems。 と能力。To train everification 結合運用之能力。To fulf engineering pu 手能力。To fulf engineering and を業更迭ます。To overcoming and を業更迭ます。 To in concept of in 究走向,具備純熟 and the change of ability of read	nformation the advance n the auxi of the har To train ractice。 ill the leation。 fulfill the continuous 其備多元專長 ndustry der tellectual 独科技英文股 of global n ing, conven	engineering。 ed ability of  liary ability between rdware practice。 the integrate ability ading ability in high e ability of questions learning。 是之能力。To obtain mand as well as to property。  閱讀溝通寫作之能力。To market and the future rsation and technical	Con	urse Objectives and Dept.'s Education Objectives			

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

教學策略 Teaching Strategies						
✓ 課堂講授 Lecture						
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 Industy-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:						

學期成績計算及多元評量方式 Grading & Assessments									
配分項目	配分比例	多元評量方式 Assessments							
Items	Percentage	測驗 會考	實作 觀察	口頭 發表	專題 研究	創作 展演	卷宗 評量	證照 檢定	其他
平時成績 General Performance									
期中考成績 Midterm Exam	40%	>							
期末考成績 Final Exam	40%	<b>~</b>							
作業成績 Homework and/or Assignments									
其他 Miscellaneous (oral presentation and 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)

 $\label{thm:condition} \mbox{Teaching Aids \& Teacher's Website} (\mbox{Including online teaching information.}$ 

Personal website can be listed here.)

meet.google.com/pue-oprt-kmj

其他補充說明(Supplemental instructions)