هيئة تقويم التعليم
Education Evaluation Commission
المركز الوطني للتقويم والاعتماد الأكاديمي
National Center for Academic Accreditation and Evaluation

ATTACHMENT 5.

T6. COURSE SPECIFICATIONS (CS)

(PHYS 544)
Solar Cells

by

Prof. Ahmed El-Naggar
2018

هيئة تقويم التعليم
Education Evaluation Commission

Course Specifications

Institution: King Saud University	Date:
College/Department : College of Science, Physics and Astronomy Department	

A. Course Identification and General Information

1. Course title and code: Solar Cells (PHYS 544)
2. Credit hours: **2(2+0)**
3. Program(s) in which the course is offered. (If general elective available in many programs indicate this rather than list programs) Physics and other science and engineering programs
4. Name of faculty member responsible for the course Prof. Ahmed El-Naggar
5. Level/year at which this course is offered: 3rd level (post-graduate)
6. Pre-requisites for this course (if any):
7. Co-requisites for this course (if any):
8. Location if not on main campus: Main campus in Diriyah , College of Science, Department of Physics & Astronomy (Boys and Girls sections)
9. Mode of Instruction (mark all that apply):

a. traditional classroom	√	What percentage?	10%
b. blended (traditional and online)	√	What percentage?	10%
c. e-learning		What percentage?	
d. correspondence		What percentage?	
f. other		What percentage?	

Comments:

B Objectives

1. What is the main purpose for this course?
   - The student should get acquainted with the fundamentals of Solar Cells generations and their applications.
   - The student should be able to apply this course in his/her future research work, as exploitation of solar cells applications in Saudi Arabia or in other counties.

2. Briefly describe any plans for developing and improving the course that are being implemented. (e.g. increased use of IT or web based reference material, changes in content as a result of new research in the field)
   - Electronic materials and computer based programs have been utilized to support the lecture course material.
   - The course material was posted on the Website that could be accessed by the students enrolled in the course.
   - Demonstration of lab experiments related to the solar cells fabrication and applications.

C. Course Description (Note: General description in the form used in Bulletin or handbook)

Course Description:
The characteristics of sunlight, Semiconductors and P-N junctions, The behavior of solar cells, Cell properties and design, Principals of solar cell operation, Low cost industrial technologies of crystalline silicon solar cells, Thin silicon solar cells, CdTe thin-film PV modules, Cu(In, Ga)Se_2 thin film solar cells, Space and concentrator solar cells, High efficiency concentrator solar cells, Photo-electrochemical solar cells, Organic and plastic solar cells.

1. Topics to be Covered

List of Topics	No. of Weeks	Contact hours
Chapter 1: The characteristics of sunlight	1 week	2
Chapter 2: Semiconductors and P-N junctions	1 week	2
Chapter 3: The behavior of solar cells	1 week	2
Chapter 4: Cell properties and design	1 week	2
Chapter 5: Principals of solar cell operation	1 week	2
Chapter 6: Low cost industrial technologies of crystalline silicon solar cells:	1 week	2
Chapter 7: Thin silicon solar cells:	1 week	2
Chapter 8: CdTe thin-film solar cells and PV modules	1 week	2
Chapter 9: Cu(In, Ga)Se_2 thin film solar cells	1 week	2
Chapter 10: Space and concentrator solar cells	1 week	2
Chapter 11: High efficiency concentrator solar cells	1 week	2
Chapter 13: Photo-electrochemical solar cells	1 week	2
Chapter 14: Organic and plastic solar cells	1 week	2
Chapter 15: Quantum dot solar cells	1 week	2

2. Course components (total contact hours and credits per semester):

		Lecture	Tutorial	Laboratory/ Studio	Practical	Other:	Total
Contact Hours	Planed	30					30
	Actual	30					30
Credit	Planed	30					30
	Actual	30					30

3. Additional private study/learning hours expected for students per week. 2 hours

4. Course Learning Outcomes in NQF Domains of Learning and Alignment with Assessment Methods and Teaching Strategy

On the table below are the five NQF Learning Domains, numbered in the left column.

First, insert the suitable and measurable course learning outcomes required in the appropriate learning domains (see suggestions below the table). **Second**, insert supporting teaching strategies that fit and align with the assessment methods and intended learning outcomes. **Third**, insert appropriate assessment methods that accurately measure and evaluate the learning outcome. Each course learning outcomes, assessment method, and teaching strategy ought to reasonably fit and flow together as an integrated learning and teaching process. (Courses are not required to include learning outcomes from each domain.)

Code #	NQF Learning Domains And Course Learning Outcomes	Course Teaching Strategies	Course Assessment Methods
1.0	**Knowledge**		
	- To understand the fundamentals of sunlight - To get acquainted with the behaviour of solar cells - To get an experience and knowledge with the principles solar cells operation. - To use different formulas to design models for solar cells	•Introducing the basic links between solar cells design and their applications •Homework assignments •Lecture discussions	- In-class quizzes - Midterms and final exams
2.0	**Cognitive Skills**		
	- The daily life applications of the studied topics. - The most famous and useful instruments build on the studied topics. - How technology is built from simple to advanced present states - some interesting experiments and applications in the field of solar cells	- Defining duties for each chapter - Advising students to search on some of the mentioned technologies (in the course) either on the websites or in the library and make reports.	* The interaction during the lectures and discussions * The reports of different asked tasks * Part of the Exams should focus on the understanding
3.0	**Interpersonal Skills & Responsibility**		
	- Writing reports - Developing the English language - Thinking in solving problems - Searching on the internet - Collecting the materials of the course	-Learning how to search on the internet and use the library -Learning how to cover missed lectures	-Through discussions in the lectures -Checking reports -Asking questions -Quizzes and Exams

	- Dealing with the lectures that the student missed. - Also the students should know how to do that independently and through discussions with the others.	-Learning how to summarize lectures or to collect materials of the course -Learning how to solve difficulties in learning: solving problems – enhance educational skills -Developing his interest in Science through :(lab work, field trips, visits to scientific and research institutes). - Encouraging the student to attend lectures regularly by giving bonus marks for attendance - Giving students tasks and duties - Learning how to write reports: some of them in English language.	
4.0	**Communication, Information Technology, Numerical**		
	- Communication with others: the lecturer – students in the class - Information Technology through: the Internet – the computer skills - Numerical skills through: solving problems- computation – data analysis)	- Advising the students to: help each other in education. -communicating with the lecturer to discuss difficulties. - Asking students to: make search on the internet for some related interesting topics. -writing reports on the computer - Asking for solving some problems and recalculating some examples.	- Discussing reports on: problems solutions - internet searching - Making discussion on some explored points - Exams
5.0	**Psychomotor**		
	Not applicable	Not applicable	Not applicable

5. Schedule of Assessment Tasks for Students During the Semester			
	Assessment task (i.e., essay, test, quizzes, group project, examination, speech, oral presentation, etc.)	Week Due	Proportion of Total Assessment
1	Weekly Homework assignments		10%
2	Attendance and Participation in the class		5%
3	First Mid-term exam	6th week	20%
4	Second Mid-term exam	10th week	25%

D. Student Academic Counseling and Support

1. Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice. (include amount of time teaching staff are expected to be available each week) • Office hours 2 hr/ week • Additional sessions 1hr/ week aided by 1 lab assistant

E Learning Resources

1. List Required Textbooks 1- Peter Wurfel and Uli Wurfel ,"Physics of Solar Cells: From Basic Principles to Advanced Concepts" Wiley-VCH; 3 edition (September 13, 2016). 2- Stephen Fonash , "Solar Cell Device Physics" Academic Press; 2 edition (April 27, 2010). 3- *Martin A. Green* ,"Solar Cells: Operating Principles, Technology, and System Applications"*, Prentice Hall (October 1, 1981)* 4- Martin A. Green ,"Third Generation Photovoltaics: Advanced Solar Energy Conversion" Springer; 1st ed. 2003. 2nd printing 2005 edition (December 21, 2005***).*** 5- Stuart R Wenham (Editor), Martin A Green (Editor), Muriel E Watt (Editor), Richard Corkish (Editor) , "Applied Photovoltaics" Routledge; 2nd edition (December 1, 2006)
2. List Essential References Materials (Journals, Reports, etc.) 1- Peter Wurfel and Uli Wurfel ,"Physics of Solar Cells: From Basic Principles to Advanced Concepts" Wiley-VCH; 3 edition (September 13, 2016). 2- Stephen Fonash , "Solar Cell Device Physics" Academic Press; 2 edition (April 27, 2010). 3- *Martin A. Green*," Solar Cells: Operating Principles, Technology, and System Applications"*, Prentice Hall (October 1, 1981)* 4- Martin A. Green ,"Third Generation Photovoltaics: Advanced Solar Energy Conversion" Springer; 1st ed. 2003. 2nd printing 2005 edition (December 21, 2005***).*** 5- Stuart R Wenham (Editor), Martin A Green (Editor), Muriel E Watt (Editor), Richard Corkish (Editor) , "Applied Photovoltaics" Routledge; 2nd edition (December 1, 2006)
3. List Electronic Materials, Web Sites, Facebook, Twitter, etc. Websites on the internet that are relevant to the course topics
4. Other learning material such as computer-based programs/CD, professional standards or regulations and software. Multimedia associated with the text book and the relevant websites

F. Facilities Required

Indicate requirements for the course including size of classrooms and laboratories (i.e. number of seats in classrooms and laboratories, extent of computer access, etc.)
1. Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.) • Lecture room with at least 25 seats • Auditorium of a capacity of not less than 25 seats for large lecture format classes Laboratory with at least 25 places
2. Technology resources (AV, data show, Smart Board, software, etc.)

• Computer room containing at least 15 systems • Scientific calculator for each student.
3. Other resources (specify, e.g. if specific laboratory equipment is required, list requirements or attach list) • Availability of demonstrative materials relevant to the course material • Safety and Lab facilities

G Course Evaluation and Improvement Processes

1. Strategies for Obtaining Student Feedback on Effectiveness of Teaching • Course evaluation by student • Students- faculty meetings
2. Other Strategies for Evaluation of Teaching by the Instructor or by the Department • Peer consultation on teaching • Departmental council discussions • Discussions within the group of faculty teaching the course
3. Processes for Improvement of Teaching • Conducting workshops given by experts on the teaching and learning Methodologies. • Periodical departmental revisions of methods of teaching. • Monitoring of teaching activates by senior faculty members.
4. Processes for Verifying Standards of Student Achievement (e.g. check marking by an independent member teaching staff of a sample of student work, periodic exchange and remarking of tests or a sample of assignments with staff at another institution) • Providing samples of all kinds of assessments in the departmental course portfolio of each course • Assigning group of faculty members teaching the same course to grade same questions for various students. • Faculty members from other institutions are invited to review the accuracy of the grading policy.
5. Describe the planning arrangements for periodically reviewing course effectiveness and planning for improvement. • The course material and learning outcomes are periodically reviewed and the changes to be taken are approved in the departmental meetings and higher councils. • The head of department and faculty dean take the responsibility of implementing the proposed changes.

Name of Course Instructor: **Prof. Ahmed El-Naggar**
Signature: _____ Date Specification Completed: **1-1-2018**
Program Coordinator: _____
Signature: _____ Date Received: _____