هيئة تقويم التعليم والتدريب
Education & Training Evaluation Commission

# Course Specifications

| | |
|---|---|
| **Course Title:** | **Solar Cells Physics** |
| **Course Code:** | **2034219- 3** |
| **Program:** | **Bachelor in Physics** |
| **Department:** | **Physics Department** |
| **College:** | **College of Science** |
| **Institution:** | **Taif University** |

## Table of Contents

## A. Course Identification

| |
|---|
| **1. Credit hours: 3** |
| **2. Course type**<br>**a.** University ☐ College ☑ Department ☐ Others ☐<br>**b.** Required ☐ Elective ☑ |
| **3. Level/year at which this course is offered: 12th Level / 4th Year** |
| **4. Pre-requisites for this course** (if any)**: None** |
| **5. Co-requisites for this course** (if any)**: None** |

**6. Mode of Instruction** (mark all that apply)

| No | Mode of Instruction | Contact Hours | Percentage |
|---|---|---|---|
| 1 | **Traditional classroom** | 4 | 100% |
| 2 | **Blended** | 0 | 0% |
| 3 | **E-learning** | 0 | 0% |
| 4 | **Distance learning** | 0 | 0% |
| 5 | **Other** | 0 | 0% |

**7. Contact Hours** (based on academic semester)

| No | Activity | Contact Hours |
|---|---|---|
| 1 | **Lecture** | 40 |
| 2 | **Laboratory/Studio** | |
| 3 | **Tutorial** | |
| 4 | **Others** (specify) | |
| | **Total** | **40** |

## B. Course Objectives and Learning Outcomes

**1. Course Description**

This elective course presents an important addition to the required courses of the program. The topic of solar cells aims to teach the student the important application of semiconductors in converting the solar radiation to electric power. The student learns the working principle of solar cells from fundamental semiconductor physics, and understands the role of a photovoltaic system in the production of electric power from sun radiation. Part of the course introduces the student to modern last generation solar cells.

**2. Course Main Objective**

-Recognize the correlation between the semiconductor physics and the working principle of the solar cell, and hence the important application of semiconductors to convert the sun radiation to electric power via the solar cell device.
-Acquire knowledge on the function of photovoltaic systems (solar cell arrays and solar cell panels) to produce large scale electric power.

### 3. Course Learning Outcomes

| CLOs | | Aligned PLOs |
|---|---|---|
| 1 | **Knowledge and Understanding** | |
| 1.1 | Outline the working principle of the conventional solar cells. | K1 |
| 1.2 | Recognize the role optoelectronic materials and associated technology in the field of new generation solar cells. | K3 |
| **2** | **Skills :** | |
| 2.1 | Apply the fundamentals of solar cells to draw the equivalent circuit of real solar cells and determine their power conversion efficiency. | S1 |
| 2.2 | Develop skill versatility in solving theoretical and practical problems related to solar cells and solar systems. | S4 |
| **3** | **Values:** | |
| 3.1 | Show responsibility in working independently with continuous improvement of personal capacities. | V1 |

## C. Course Content

| No | List of Topics | Contact Hours |
|---|---|---|
| 1 | Generations of solar cells: First, second and third. | 3 |
| 2 | Photovoltaic effect | 3 |
| 3 | Basic Semiconductor Physics | 4 |
| 4 | Generation and recombination of electron-hole pairs under light excitation. | 2 |
| 5 | Midterm exam | 2 |
| 6 | Solar cell equivalent circuit and parameters extraction. | 3 |
| 7 | Crystalline Silicon Solar Cells | 3 |
| 8 | Thin-film solar cells | 3 |
| 9 | Periodical exam | 2 |
| 10 | Organic Solar cells | 3 |
| 11 | Combination of photovoltaic generator and load resistor. | 2 |
| 12 | Energy storage units (Solar Batteries). | 4 |
| 13 | DC-DC and DC-AC convertors. | 4 |
| 14 | Final Exam | 2 |
| **Total** | | **40** |

## D. Teaching and Assessment

### 1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| **1.0** | **Knowledge and Understanding** | | |
| 1.1 | Outline the working principle of the conventional solar cells. | Lecture Discussion | Written exam |
| 1.2 | Recognize the role optoelectronic materials and associated technology in the field of new generation solar cells. | Lecture Discussion | Written exam |
| **2.0** | **Skills** | | |
| 2.1 | Apply the fundamentals of solar cells to draw the equivalent circuit of real | Lectures and Essays | Written exam Activities |

| Code | Course Learning Outcomes | Teaching Strategies | Assessment Methods |
|---|---|---|---|
| | solar cells and determine their power conversion efficiency. | | |
| 2.2 | Develop skill versatility in solving theoretical and practical problems related to solar cells and solar systems. | Problem solving | Written exam Activities |
| **3.0** | **Values** | | |
| 3.1 | Show responsibility in working independently with continuous improvement of personal capacities. | Group discussion | Essays |

### 2. Assessment Tasks for Students

| # | Assessment task* | Week Due | Percentage of Total Assessment Score |
|---|---|---|---|
| **1** | Assignments and Interaction during lectures | continuous | 10% |
| **2** | Midterm exam | $6^{th}$ | 30% |
| **3** | Short exam | $9^{th}$ | 10% |
| **4** | Final exam | $12^{th}$ | 50% |

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

## E. Student Academic Counseling and Support

**Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :**

- Each faculty member is assigned a group of students for continuous academic advice during six office hours weekly (6 hrs./week).
- Also teaching staff are available for individual student consultations during office hours

## F. Learning Resources and Facilities

### 1.Learning Resources

| | |
|---|---|
| **Required Textbooks** | **Martin A. Green,** "Solar Cells: Operating Principles, Technology and System Application" - University of New South Wales - Kensington, Australia - 1998 |
| **Essential References Materials** | Physics of Solar cells, J. Nelson, Imperial college, London, first published 2003. |
| **Electronic Materials** | |
| **Other Learning Materials** | Lecture notes and PowerPoint presentations prepared by the lecturer. |

### 2. Facilities Required

| Item | Resources |
|---|---|
| **Accommodation** (Classrooms, laboratories, demonstration rooms/labs, etc.) | • Classrooms |
| **Technology Resources** (AV, data show, Smart Board, software, etc.) | • Data show<br>• Laptop |

| Item | Resources |
|---|---|
| | • Smart board |
| **Other Resources** (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list) | |

## G. Course Quality Evaluation

| Evaluation Areas/Issues | Evaluators | Evaluation Methods |
|---|---|---|
| Student Feedback on Effectiveness of Teaching | Students | Indirect |
| Evaluation of Teaching | • Instructor<br>• Program coordinator<br>• Departmental council<br>• Faculty council | Indirect |
| Improvement of Teaching | • Program leaders<br>• Relevant committee | • Direct |
| Quality of learning resources | • Students<br>• Instructor<br>• Faculty | Indirect |
| Extent of achievement of course learning outcomes, | • Program leaders<br>• Instructor | Direct |
| Course effectiveness and planning for improvement | • Program leaders<br>• Instructor | Indirect |
| | | |

**Evaluation areas** (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
**Evaluators** (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
**Assessment Methods** (Direct, Indirect)

## H. Specification Approval Data

| | |
|---|---|
| **Council / Committee** | |
| **Reference No.** | |
| **Date** | October 2, 2022 |