Module (Course Syllabus) Catalogue

2022-2023

College/ Institute	Erbil Technology College	
Department	Department of Mechanical and Energy	
Module Name	Solar Energy	
Module Code		
Semester	3	
Credits	6	
Module type	SOE302	
Weekly hours		
Weekly hours (Theory)	(2)hr Class	(86)hr Workload
Weekly hours (Practical)	(2)hr Class	(64)hr Workload
Lecturer (Theory)	Latef M. Ali	
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Lecturer (Practical)	Latef M. Ali	
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Course Description	This course will provide the students with an up-to-date basic knowledge of the physical and chemical principles of materials used in solar cells of various kinds including but not limited to technologies such as: silicon-based solar cells, and other inorganic thin film solar cells, and thermal and concentrator solar power generation. The course provides an introduction to solar radiation and some important related concepts like solar spectrum, irradiance, irradiation, air mass.
Course objectives	The course focuses on technologies using the sun as energy resource. In this case, the technology uses the photovoltaic effect to transform the energy arriving from the sun into electricity. In this area it is intended that students acquire the knowledge and skills necessary for describing and selecting equipment, as well as for calculating the performance of the different components of the system and aspects of analysis and design at a basic level.
Student's obligation	Respect A student has an obligation to exhibit honesty and to respect the ethical standards of the profession in carrying out his/her academic assignments. Without limiting the application of this principle. Attendance Missed classes will not be compensated including the quizzes and the scheduled assignments. The students will lose marks on unattended classes with quizzes unless a legal document or authorized leave is presented which should explain the excuse of the absence. However, the absent student should take the responsibility for making up the missed lecture. The lectures format The lectures are divided on four weekly hours (two hours theoretically and two hours practically). Mainly, the first two theoretical hours will be dedicated for the topic backgrounds and the main principles. Notes and handouts are given to the students containing the detail of the theoretical topics.

	Theoretical lectures will be assisted by presentations using white board and data show. Discussion time is provided for the students for questions. The first practical hour will be dedicated for how to works in the laboratory, health and safety, how to use equipment, boards, components, and wire connection to do experiments and reports. Students should submit every week a report about the previous experiment. Questions Asking questions about unclear material is an important part of the classroom experience. It is not uncommon for students to have similar difficulties, so speaking up will help everyone understand the discussed information. Teachers can also benefit from a student's questions. By finding out what subjects are hard to understand, instructors can adjust their lectures to clear up confusing topics. Assignment A student must submit the assignment on moodle app. every week and also write a report about what he/she was studied in the laboratory.
Assessment scheme	16% Mid Term (Theory and practical) 4% Quiz 40% Assignment (report, paper, homework, seminar...) 25% final practical 15% final theory
Specific learning outcome:	To understand the role of solar energy in the context of regional and global energy system, it's economic, social and environmental connotations, and the impact of technology on a local and global context. 1. To understand the physical principles of the photovoltaic (PV) solar cell and what are its sources of losses. 2. To understand and apply the basic concepts of solar radiation necessary for dimensioning (sizing) PV systems installations. 3.to know the electrical (current-voltage and power-voltage) characteristics of solar cell, panel or generator and how the environment parameters influence it 4.to know the most important characteristics of the elements within a PV system and how they work: battery and charge

	controller, DC/DC converter, DC/AC converter (inverter) and loads.
Course References:	1. Luque, Antonio ; Hegedus, Steven. Handbook of photovoltaic science and engineering [on line]. Chichester, West Sussex, U.K: Wiley, 2011 2. - Universität Kassel. Photovoltaic Systems Technology [on line]. SS 2003. Kassel: Universität Kassel, 2003 3. Castañer Muñoz, Luis ; Silvestre Berges, Santiago. Modelling photovoltaic systems : using PSpice. Chichester: John Wiley & Sons, 2002. 4- Alonso Abella, Miguel. Sistemas fotovoltaicos : introducción al diseño y dimensionado de instalaciones de energía solar fotovoltaicas. 2a ed. Madrid: 5 - Alcor Cabrerizo, Enrique. Instalaciones solares fotovoltaicas. 4a ed. Sevilla: PROGENSA, 2008.

Course topics (Theory)	Week	Learning Outcome
This week will focus on Fundamentals on the light, energy, electromagnetic spectrum, conservation of energy, second law of thermodynamics, solar irradiation and spectrum, photovoltaic effect and photovoltaic history.	1	
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This week lecture will cover band gap (direct and indirect gap semiconductors), absorption, types of semiconductors (intrinsic and extrinsic) and fundamental processes in a solar cell starting from light absorption to charge collection.	3	
This week lecture will cover band gap (direct and indirect gap semiconductors), absorption, types of semiconductors (intrinsic and extrinsic) and fundamental processes in a solar cell starting from light absorption to charge collection.	4	

This week lectures will focus on the types of recombination and efficiency limits of solar cells.	5	
The concept of electron transport, drift and diffusion, electronic band structure, band bending and doping will be covered.	6	
Junctions (p-n, p-i-n), origin of photovoltaic action, Shottky and Ohmic contacts, p-n junction characteristics under dark and light will be addressed.	7	
Silicon solar cells, architectures, processing and other inorganic materials for solar energy.	8	
Questions from the mid-term exam will be discussed.	9	
Organic solar cells: materials and state-of-the-art.	10	
Optical characterization methods for solar cells	11	
Electrical characterization methods for solar cells	12	
Practical Topics	Week	Learning Outcome
Design of Solar Inverter Circuit for Homes	1	
Solar Tracking Solar Panel Using ATMEGA8 Controller	2	
Wireless Solar Charger	3	
Solar inverter using sg3525	4	
Solar inverter using sg3525	5	
Testing Photovoltaic Cells	6	
Testing Photovoltaic Cells	7	
Effect of Shading on Cell Current – PV Cells in Series	8	
Performing the Activity for Temperature	9	
The effect of azimuth angle on generation.	10	

An estimate of maximum power output	11	
An estimate of energy efficiency	12	

Academic year: 2021 – 2022
Final exam / First attempt

Note (Each Branch carried 10 Marks)

Q1/ *A*-What are the FOUR advantages of solar energy?

B- From the solar cell by what device the DC current transform into AC.

C-What are the differences between electron current and hole current in a semiconductor?

Q2/ A- What are the TWO advantages ofVertical Axis Wind Turbine?

B-What are three functions of control systems?

C -Describe doping processes in Semiconductor?

D- Write four important parts of a wind Turbine?

Q3/ Choose the correct answer from the multiple-choice list with the reason.

A. The photovoltaic effect occurs in ……. materials.
a- Insulator *b*- Semiconductor *c*- Conductor

B. Electrons are the minority carriers in. *a*- Extrinsic Semiconductors
b- p-type Semiconductors. *c*- n-type Semiconductors.

C. What form of energy is the desired input of the wind turbine? *a*-Electrical Energy *b.*Mechanical Energy *c*- Kinetic Energy.

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Lecturer

Assist. Prof. Dr. Latef M. Ali