Philadelphia University

Faculty of Engineering - Department of Renewable Energy Engineering

First Semester 2025/2026

Course Information

Title:	Smart Grids (611546)
Prerequisite:	Electrical Power Systems (611430)
Credit Hours:	3 credit hours (16 weeks per semester, approximately 45 contact hours)
Textbook:	• The Advanced Smart Grid: Edge Power Driving Sustainability, by Carvallo Andres and John Cooper, 2015.
References:	• Unlocking Smart Grid Opportunities in Emerging Markets and Developing Economies, by the International Energy Agency, 2023.
Catalog Description:	This is an elective course for the Renewable Energy Engineering Students. Smart grids are advanced grids that enable the seamless integration of utility infrastructure with buildings, homes, electric vehicles, distributed generation, energy storage, and smart devices to increase grid reliability. Smart grids have become necessary with the fast growth of integrating renewable energy systems into the main grid. Optimization algorithms play a main role in obtaining an optimal power flow based on data exchange within the electrical grid.
Website:	https://www.philadelphia.edu.jo/academics/zalmuala/

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Office hours: Sat, Mon: 09:00-09:45 & 11:00-12:40

Sun, Tues: 09:30 – 11:00 & 12:40-13:40

Course Topics

Week	Topic
1,2	Background
3,4	Advanced metering infrastructure
5	Renewable energy integration
6, 7	Energy storage and electric vehicles
8	Microgrid
9	Energy efficiency and demand response
10, 11	Smart grid regulations and new tariff structure
12	AI: optimization algorithms
13	Optimal energy management using optimization algorithms (PSO, GA, GWO)
14, 15	Case study in MATLAB
16	Review and final exam

Course Learning Outcomes and Relation to ABET Student Outcomes: Upon successful completion of this course, a student should:

1.	Understand the concepts and principles of smart grid.	[K1, K2]
2.	Know the various enabling technologies for the evolution of the smart grid	[K1, K3]
3.	Understand the impacts of renewable resources on the grid and the various issues associated with integrating these resources with the electric grid.	[K2, S3]
4.	Identify the contemporary challenges in implementing smart grids and increasing adoption of renewable sources	[K3, S2]
5.	Solve grid problems associated with increasing penetration of renewable energy resources	[K1, S3]

Assessment Instruments:

Evaluation of students' performance (final grade) will be based on the following categories:

Exams:	Two written exams will be given. Each will cover about 3-weeks of lectures
Quizzes:	10-minute quizzes will be given to the students during the semester. These quizzes will cover material discussed during the previous lecture(s).
Homework:	Problem sets will be given to students. Homework should be solved individually and submitted before the due date.
	Copying homework is forbidden, any student caught copying the homework or any part of the homework will receive zero mark for that homework
Participation:	Questions will be asked during lecture and the student is assessed based on his/her response
Final Exam:	The final exam will cover all the class material.

Grading policy:

Mid Exam	30%
Homework	30%
Final Exam	40%
Total:	100%

Attendance policy:

Absence from classes and/or tutorials shall not exceed 15%. Students who exceed the 15% limit without a medical or emergency excuse, acceptable to and approved by the Dean of the relevant college/faculty, shall not be allowed to take the final examination and shall receive a mark of zero for the course. If the excuse is approved by the Dean, the student shall be considered to have withdrawn from the course.

October, 2025