
Syllabus

Catalog Course description

A laboratory course that covers: PV modules: characteristics, effect of alignment, temperature, irradiance and shading, maximum power tracking, implementation of grid tie, grid tie with battery backup, stand alone and direct PV systems. Wind turbine: implementation of a stand-alone and grid tie systems, Doubly-fed induction generator, synchronization, effect of wind speed on voltage and frequency, optimal operating point, fault ride through testing, balanced and unbalanced faults.

Time/Place

The course is provided in the online environment using Moodle and in the Mechanical Lab (*IOEC 323-Energy Teaching Laboratory*) at the American University of Beirut. The lab is accessed physically by students in Lebanon, and virtually by students abroad *(using TeamViewer*). Lab timing to be agreed on during the first two weeks of the semester.

Required or elective

- Elective
- Energy Specialization lab course

Course Resources

Lecture notes - Experiment Manuals - Laboratory Manual

Course Objectives

The objectives of this course are:

1. To provide students information to supplement the prerequisite courses
2. To provide students with the ability to conduct testing and experimental procedures on renewable energy devices
3. To provide students hands-on experience in implementing and analyzing different PV and wind turbine systems
4. To familiarize students with the applications of the different renewable energy systems

Course Outline

1. Grid tie PV system
2. Grid tie with battery backup PV system
3. Stand alone PV system
4. PV direct system
5. Characteristics of PV modules
6. Effect of alignment, temperature, irradiance and shading on a PV module
7. Maximum power tracking in a PV module
8. Stand alone wind turbine system
9. Steady state behavior of a grid tie wind turbine
10. Dynamic behavior of a grid tie wind turbine

Course outcomes

At the end of the course, students:

1. Construct the characteristics of the PV module
2. Seek the maximum power point of the PV module
3. Outline the effects of alignment, temperature, irradiance and shading on a PV module
4. Analyze a practical PV system
5. Synchronize a wind turbine with the grid
6. Operate the wind turbine at different wind conditions and control the active and reactive power
7. Analyze a wind turbine during a fault condition

Evaluation methods

- Final Exam (20%)
- PV Project (10%)
- Wind Energy Project (10%)
- Lab Work
  - Pre-Labs (20%)
  - Post-Labs (20%)
  - Quizzes (15%)
- Student contribution (Discussion Forums) (15%)

Professional component

Engineering education: 65 %
Technology: 25 %
Mathematics and basic sciences: 10 %

Computer usage

MatLab, LabVIEW, Homer, PVsyst

Document Preparation

- **Person(s) who prepared this description and date of preparation**
  Sami Karaki, Hisham Ashkar, August 2013
- **Edited and Reviewed**

  Dima Fares, December 2016