The University of Jordan
School of Engineering
Electrical Engineering Department
2nd Semester – A.Y. 2023/2024

Course:	Renewables & Power System Quality – 0973581 (3 Cr. – Elective Course)
Instructor:	Prof. Eyad A. Feilat Office: E306, Telephone: 06/5355000 ext 22857, Email: e.feilat@ju.edu.jo Office Hours: Will be posted soon http://elearning.ju.edu.jo/
Platform:	
Catalog description:	The solar energy source: Altitude and tilt angles, sun path diagrams for shading analysis, clear sky insolation. Photovoltaic materials and electrical characteristics. Photovoltaic cell model, modules and arrays, I-V curves under standard test conditions and shading impacts. Crystalline silicon and thin film technologies. Photovoltaic systems: Current-voltage curves for loads. Grid connected and standalone systems. Wind energy systems: Types of wind turbines, power in the wind, wind turbine generators, speed control of generators, wind turbine economics. Power system quality: current and voltage total harmonic distortion, harmonics sources, effects and mitigation. Voltage flickers, sags and swells.
Prerequisites by course:	EE 0953481 Power System Analysis (pre-requisite)
Prerequisites by topic:	Students are assumed to have a background in the following topics: •Basic electrical circuit analysis techniques. •Transformers and synchronous machines. •Power systems components and layout. •Power System Analysis. •Electric Machines. •Power electronics.
Textbook:	• Renewable and efficient power systems, 2nd edition by Gilbert Masters, 2013. • Dugan, McGranaghan, Santoso, and Beaty, “Electrical Power Systems Quality” McGraw-Hill, 2nd Ed., 2003.

1. Electric Energy: An Introduction, 3rd edition by Mohamed A. El-Sharkawi, 2020.
2. Renewable energy system design, Ziyad Salameh, 2014.
3. Renewable energy in power systems, L. Freris, and D. Infield, Wiley, 2008.
4. Wind and solar power systems, M. Patel, 2000.

References:

5. Wind energy systems for electric power generation, M. Stiebler, 2008.

6. Francisco C. De Larose, Harmonics and Power Systems , CRC 2006.

7. Arindam Ghosh and, Gerard Ledwich, Power Quality Enhancement Using Custom Power Devices, Kluwer Academic Publishers, USA, 2002.
8. Jos Arrillaga, Neville R. Watson “Power System Harmonics”, 2nd Edition, John Wiley & Sons, Ltd, 2004.

On Campus [16 Weeks, 42 lectures (50 minutes each) including exams]

Schedule:

Course goals: The overall objective is to provide the student with the knowledge of renewable energy systems, mainly solar and wind, and their impacts on electric power systems. This

Course learning outcomes (CLO) and relation to ABET student outcomes (SO):

Upon successful completion of this course, a student will:	[SO]
1. be able to understand the renewable energy sources available at present.	[7]
2. be able to understand the solar energy operation and its characteristics.	[1]
3. be able to understand the wind energy operation and its types.	[1]
4. be able toidentify and classify power quality disturbances, their causes, and their impact on electric equipment .	[2]
5. be become familiar with the most important and widely used industry standards to	[2]
6. control harmonic distortion levels as well as the terminology used in power quality be able to recommend appropriate mitigation techniques for power quality problems .	[2]
7. be able to understand the definition and modeling of power system harmonics under 8. be able to understand the principle of operation and design of single-tuned filters as one	[2]

Course topics:

	Hrs
1. Solar energy source: Solar position, solar irradiation, solar time, incidence angle, measuremnent instruments, sun path diagrams, optimal tilt angle.	5
2. PV cells, Ideal PV model, I-V curves, effect of irradiance and temperature on solar cells, PV module, PV array, PV real model, shading impacts. Inverters and Other PV system components.	6
3. Grid-connected PV system design: sizing, shading analysis and energy calculation.	4
4. Wind power generation: wind turbine, wind power curve, wind speed statistics, energy calculation, overview of wind turbines: wind generators, Induction generator, synchronous	2
5. generatorElectrical Power Systems Quality Problems: Terms And Definitions	4 10
6. Power System Harmonic Distortion and Power Quality Indices	6
7. Harmonic Analysis, Harmonic Source Modelling, Harmonic Mitigation & Control.	
8. Harmonic Filter Design.	

Ground rules:

Attendance is required and highly encouraged. To that end, attendance will be taken every lecture. Eating and drinking are not allowed during class, and cell phones must be set to silent mode. All exams (including the final exam) should be considered cumulative. Exams are closed book. No scratch paper is allowed. You will be held responsible for all reading material assigned, even if it is not explicitly covered in lecture notes. Academic integrity must be maintained.

Assessment & grading policy:

First Exam 0% Assignments 0% Midterm Exam 30% Projects 20% Final Exam 50% Lab Reports 0%

Quizzes	0%	Presentation	0%
		Total	100%

Last Revised: January 2024