Course:	**ECE 51501: Smart Grid**
Credit and contact hours:	(3 cr.) Class 3
General information:	This is a hybrid course. Students will watch the video lectures online through Canvas (canvas.iu.edu) with some on campus activities, such as project presentations.
Description:	The course introduces students to the history of the U.S. power grid and to the basic concepts of the current electric power system. The main challenges of the transition from the traditional power system with unidirectional power flow to the new and complex system connected to renewable sources and bidirectional power flow capability is also presented in this course. In addition, the impact of distributed generation and electric vehicles is discussed along with cybersecurity and information privacy issues inherent in this new power grid.
Prerequisite:	ECE 30100
Textbook:	There is no need to buy any book for this course, the handout "*The Future of the Electric Grid*" will be available for free download. • James Momoh, *SMART GRID: Fundamentals of Design and Analysis*, 1st Ed., Wiley-IEEE Press, 2012, ISBN: 978-0-470-88939-8 • The Future of the Electric Grid: An Interdisciplinary MIT Study. ISBN 978-0-9828008-6-7. Available online at: http://mitei.mit.edu/publications/reports-studies/future-electric-grid
Reference	• Daniel Yergin, *The Quest: Energy, Security, and the Remaking of the Modern World Paperback* – September 26, 2012 .
Coordinator:	Dr. Euzeli Santos, Professor of Electrical and Computer Engineering
Goals:	Understanding the differences between power grid employed worldwide since the end of the 19th century and the new power grid system with distributed energy sources. Outline the key issues involved in enhancing: the distribution system, engaging electricity demand and utility regulation. Learn the main challenges and the solutions to mitigate the issues associated with the integration of variable energy resources, transmission expansion, and the impact of distributed generation and electric vehicles. Introduction to the concepts of data communications, cybersecurity, and information privacy on a smart-grid environment.

Outcomes:	*After the successful completion of this course, a student should be able to:* i. Describe the operation of both: (1) the conventional power grid system, which includes its generation, transmission and distribution; and (2) the new power grid system with distributed energy sources along the transmission and distribution lines. ii. Develop simplified models to describe different components on both traditional and the smart grid. iii. Design and specify renewable energy systems (e.g., solar and wind energy sources) as well as storage devices (e.g., batteries) connected to the smart grid. iv. Develop load flow analysis of power grids. v. Understand the main data communications standards. vi. Classify the cybersecurity vulnerabilities and understand the risks of an attack on the grid.
Topics:	**Outline:** 1. A Brief History of the U.S. Grid 2. Electric Power System Basics 3. Challenges, Opportunities, and Major Recommendations 4. Enhancing the Transmission Network and System Operations 5. Integration of Variable Energy Resources 6. Modeling Sources Connected to the Grid 7. Transmission Expansion 8. Solar and Wind Power Generation 9. The Impact of Distributed Generation and Electric Vehicles 10. Macro and Micro Grids 11. Enhancing the Distribution System 12. Engaging Electricity Demand

	13. Utility Regulation 14. Data Communications, Cybersecurity, and Information Privacy
Computer usage:	MATLAB.
Evaluation methods:	Homework assignments 20% Exam 35% Course Project 45%. Grading Scale o >97% A+ Excellent achievement; Demonstrates extraordinarily high achievement. o from 93% to 96.99% A o from 90% to 92.99% A- Very good work; Represents solid and acceptable performance that is above average in comprehension. o from 87% to 89.99% B+ o from 83% to 86.99% B o from 80% to 82.99% B- o from 77% to 79.99% C+ Work completed Marginal work; Represents average performance and average comprehension. o from 73% to 76.99% C o from 70% to 72.99% C- o F: <70%, Unacceptable work; The student has failed to meet the requirements of the class.

	This course will follow the rules of Academic Misconduct in Academic Handbook and Code of Student Rights, Responsibilities Conduct. **The student code of conduct website can be accessed at: Academic Handbook and *Code of Student Rights, Responsibilities, and Conduct*) http://www.iu.edu/~code/** • ADA (American with Disabilities Act) compliance: Include these statements in the syllabus: "If you need any special accommodations or assistance due to a disability, contact Adaptive Educational Services (AES) at (317)-274-3241. The office is located in Joseph T. Taylor Hall (UC), Room 100. AES website: http://aes.iupui.edu/services.html. No qualified individual with a disability shall, by reason of such disability, be either excluded from participation in or be denied the benefits of the services, programs, or activities" of Indiana University-Purdue University Indianapolis."
ABET category:	Engineering science 2 credit or 67%, Engineering design 1 credits or 33%
Prepared by:	Euzeli Santos
Date:	April 5th 2022