PURDUE UNIVERSITY | College of Engineering

Engineering Faculty Document No.: 130-25
February 24, 2025

TO: The Engineering Faculty

FROM: The Faculty of the Elmore Family School of Electrical and Computer Engineering

RE: New undergraduate course – ECE 41015

The Faculty of the Elmore Family School of Electrical and Computer Engineering has approved the following new undergraduate course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

FROM (IF ALREADY OFFERED WITH TEMPORARY NUMBER):

ECE 49595 Introduction to Smart Grid

3 total credits; 3 credit lecture

ECE 32100 and (PHYS 27200 or PHYS 24100 or PHYS 25100 or PHYS 26100) and (MA 26200 or MA 26600 or MA 36600)

Offered at IUPUI before the expansion/merge with 30 students enrolled

TO:

ECE 41015 Introduction to Smart Grid

3 total credits; 3 credit lecture

ECE 32100 and (PHYS 27200 or PHYS 24100 or PHYS 25100 or PHYS 26100) and (MA 26200 or MA 26600 or MA 36600)

This course is an introduction to the concepts of data communications, cybersecurity, and information privacy on a smart-grid environment. 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, this course outlines the key issues involved in enhancing: the distribution system, engaging electricity demand and utility regulation. Students will learn the main challenges and solutions to mitigate the issues associated with the integration of variable energy resources, transmission expansion and the impact of distributed generation and electric vehicles.

RATIONALE:

This course previously ran at IUPUI as a graduate-level course but the area would like it at an undergraduate level first and then continue with a new, more advanced graduate level course at a later time. This course is also an area of the Power & Energy Systems Concentration not yet covered.

Mithuna Thottethodi
Associate Head of Teaching and Learning
Professor of the Elmore Family School of Electrical and Computer Engineering

Link to Curriculog entry: https://purdue.curriculog.com/proposal:32353/form

Course:	**ECE 41015: Introduction to Smart Grid**
Credit and contact hours:	(3 cr.) Class 3
Instructor	Euzeli Dos Santos, Associate Professor (Purdue Univ. Indianapolis)
Course Description:	This course is an introduction to the concepts of data communications, cybersecurity, and information privacy on a smart-grid environment. 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, this course outlines the key issues involved in enhancing: the distribution system, engaging electricity demand and utility regulation. Students will learn the main challenges and solutions to mitigate the issues associated with the integration of variable energy resources, transmission expansion and the impact of distributed generation and electric vehicles.
Prerequisite:	ECE 32100 and (PHYS 27200 or PHYS 24100 or PHYS 25100 or PHYS 26100) and (MA 26200 or MA 26600 or MA 36600)
Textbook:	• 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 • James Momoh, *SMART GRID: Fundamentals of Design and Analysis*, 1st Ed., Wiley-IEEE Press, 2012, ISBN: 978-0-470-88939-8
References	• Handout provided by the instructor and class notes.
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:	*A student who successfully fulfills the course requirements will have demonstrated:*

	i. The ability to describe the operation of conventional power grid systems including its generation, transmission and distribution, and the new power grid system with distributed energy sources along the transmission and distribution lines. [1]. ii. an ability to develop simplified models to describe different components on both traditional and the smart grid [1]. iii. an ability to 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 [1]. iv. An ability to develop load flow analysis of power grids. v. an understanding of the main data communications standards [1]. vi. an understanding of the cybersecurity vulnerabilities and understand the risks of an attack on the grid [1].
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.
ABET category:	Engineering science 2 credit or 67%, Engineering design 1 credits or 33%
Prepared by:	Euzeli Santos
Date:	02/26/2025