ECE New Course Request

INSTRUCTIONS for completing this form:

This cover form must be completed when proposing an ECE course for permanent catalog listing. Normally, this request is made at the same time the course is proposed for a third offering as a special topic course. If also requesting a special topic offering, then the ***ECE Special Topic Course Request*** form must be completed and submitted along with this form.

In addition to this completed form (or both completed forms), a summary of grades assigned and CIOS student evaluations for all previous offerings of the course must be provided.

After TIG approval, (1) all materials must be submitted to the chair of the ECE Undergraduate or Graduate Committee, as appropriate, and (2) this completed form must be submitted **electronically** to Doug Williams.

1. Course Title: Smart Grid	**3. Level:** ☐ 1xxx ☐ 2xxx ☐ 3xxx ☒ 4xxx ☒ 6xxx ☐ 7xxx
2. Title Abbreviation for Transcript (24 characters maximum, including spaces): Smart Grid	
4. Catalog Description (25 words or less): A comprehensive introduction to smart electricity grids covering smart devices and controls, the cyber layer, system level control, and market applications.	**5. Grade Basis:** Letter-Grade/Pass-Fail/Audit

6. Credit Hours: ☒ 3-0-3 ☐ 2-3-3 ☐ 3-3-4 ☐ Other:

Laboratory (if applicable): ☐ unscheduled ☐ scheduled

For courses with substantial laboratory or project work, a 2-3-3 or 3-3-4 credit distribution may be appropriate. Institute policy requires all lecture courses (3-0-3, most 2-3-3 or 3-3-4) to have a final exam, given during the scheduled final exam period. For courses with major projects, an alternate final exam format (e.g., oral project presentations) may be approved.

7. Taught previously as a special topic? ☐ No ☒ Yes, list terms and enrollments: Fall 2014, 27 students

8. If this course is equivalent to other graduate or undergraduate Georgia Tech course(s), list course number(s):

9. (UNDERGRADUATE only) **Satisfies:** ☐ Humanities ☐ Social Science ☐ Ethics ☐ Global Perspective

10. (GRADUATE only) **ECE MS/PhD course domain(s):**

☐ Bio ☐ CSS ☐ DSP ☐ EDA ☐ Emag ☒ Energy ☐ Micro ☐ Optics ☐ Sys&Ctrl ☐ Telecom ☐ VSDD

Approval must be obtained from ALL TIGs responsible for the specified course domain(s) before submission to ECEGC.

Form continues on next page.

FOR ECE ADMINISTRATIVE USE ONLY

Course Number(s): ________________________ ☐ verified with Registrar's Office

Approval Dates: TIG(s) __________ ECE GC/UGC __________ ECE Faculty __________

IGC/IUCC submission __________ IGC/IUCC __________ Academic Senate __________

ECE course database __________ ECE textbook database __________

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11. Prerequisites: ☐ check here if there are NO prerequisites for this course

ECE4320, ECE4330

Use an asterisk to indicate that concurrency is allowed and "[C]" to indicate that a minimum grade of C is required. For example, the prerequisites for ECE 4007 would be listed as follows: **ECE 3042[C] and ECE 4001***

ECE 4xxx courses are considered advanced topics in EE/CmpE and, therefore, generally must have another ECE course as prerequisite. Prerequisites for undergraduate courses are enforced and may not be waived by the instructor, although ECE graduate students will be granted prerequisite overrides. Prerequisites are not enforced for graduate courses.

12. Purpose of Course (*relation to other courses, programs, and curricula)***:**

Smart Grids cover a large number of topics around electricity system modernization with smart sensors, control, communication networks, analytics.

13. Special Considerations (*e.g., major or level restrictions, cross-listing with another department, non-traditional scheduling, free elective credit only, not usable toward degree requirements)***:**

14. Expected Mode of Presentation:	*MODE*	*% of COURSE TIME*
• Lecture credit hours	Lecture	80%
	Discussion	
	Seminar	
	Demonstration	20%
	Other (Specify):	
• Lab/Recitation credit hours	Scheduled	
	Unscheduled	

15. Planned Frequency of Offering:	*TERM(s) TO BE OFFERED*		*EXPECTED ENROLLMENT*
	☐ Fall	☐ Alternate years	
	☒ Spring	☒ Alternate years	40
	☐ Summer	☐ Alternate years	

16. Probable Instructors – *Please mark with an asterisk any non-tenure track individuals. (List at least two names.)*

S. Grijalva and D. Divan and A. P. Meliopoulos

17. Textbooks: ☒ **check here if NO textbooks are to be ordered for this course**

For each text to be ordered, specify either "required" or "optional" and provide the other requested information.
To specify more than three texts, include the information for the additional texts on the syllabus and check here: ☐

	Reqd/Opt	ISBN Number	Author, Title, Publisher, Year
a)	Required		
b)	Required		
c)	Required		

Form continues on next page.

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18. Brief description of how students will be evaluated or graded *(e.g., exams, homework, major project)*:

NOTE: Institute policy requires all lecture courses to have a final exam, given during the scheduled final exam period. If an alternate final exam format (e.g., oral project presentations) is proposed, describe it in this section.

2 Quizzes (15% each), One Final (30%), Homework 20%, Project 20%

19. Course Syllabus / Topical Outline (*please limit Topical Outline to 1 page in length)*:

1. Introduction to Smart Grids
2. Distribution System Modeling and Simulation

Device and Local Control Layer

3. Smart Meters
4. Substation IEDs and PMU
5. Review of Power Electronics
6. Smart Power Electronic Devices and Controls

Cyber Layer

7. Review of Communication Networks
8. Smart Grid Networks Architecture
9. Cyber-Security
10. Smart Grid Cyber-Physical Security
11. Information Systems and Smart Grid Big Data

System Control and Market Layer Applications

12. Advanced Metering Infrastructures
13. Smart Grid Analytics
14. Ancillary Services
15. Demand Response
16. Distribution Automation
17. DER Integration and Microgrids
18. Energy Storage and EV
19. Home Energy Management Systems
20. Bulk Power Applications
21. Utility Business Cases
22. Future Grid.

Form continues on next page.

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COURSE OBJECTIVES AND OUTCOMES

Core undergraduate courses (required courses or those that satisfy specific degree requirements such as probability/statistics or senior lab elective) MUST have course educational objectives and outcomes defined when submitted for permanent catalog listing. Courses proposed for satisfying certain degree requirements (e.g., senior lab electives) may be required to include certain objectives and/or outcomes. ***The following page provides detailed instructions and examples.***

20. Course Educational Objectives (Maximum of 6 objectives; maximum of 150 character each)
In brackets at the end of statement, identify the Student Outcome(s) to which that objective is contributing.

As part of this course, students …

1. will be able to describe electricity industry modernization, smart grid objectives, and assess success of smart grid projects
2. will learn the opportunities in applying modern sensors, communication networks, data management and analytics to power system problems
3. will learn a layered approach to understanding complex cyber-controlled power systems.
4. will learn methots to model and simulate key smart grid applications including demand response, EV, storage, microgrids, and home energy management.
5. will learn how smart control, power electronics, and advanced decision making are applied to increase grid flexibility and smartness
6. will learn the interdependencies of technology, economics, and business strategy as related to grid evolution.

21. Course Educational Outcomes (Maximum of 15; maximum of 150 character each)

Upon successful completion of this course, students should be able to …

1. understand and describe smart grid objectives and success metrics
2. model and simulate distribution systems overlaid with smart grid functionality
3. understand the effect of power electronics and smart sensors on grid flexibility
4. appreciate the strategic deployment of sensors including AMI, IEDs and PMUs
5. determine information requirements for smart grid applications
6. determine communication requirements for smart grid applications
7. analyze cyber-security aspects for smart grid
8. design information architectures and specific data management functionality
9. model and simulate key smart grid applications such as demand response
10. model and simulate distributed energy resources and energy storage operation in the grid
11. model and simulate the economics of smart grid applications
12. use tools to evalute business cases for smart grid applications
13. use tools to analyze business models for smart grid
14. envision how the electricity industry will evolve based on smart grid technologies.
15.

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COURSE OBJECTIVES AND OUTCOMES (Instructions and Examples)

Educational Objectives describe how a course contributes to the attainment of the degree program's Student Outcomes. For example, the course may involve the application of knowledge acquired in earlier courses, the introduction of new concepts and/or skills, or the integration of material derived from other program components. Educational Objectives should be written as the conclusion to the statement, "As part of this course, students …". Examples of appropriate course educational objectives include the following:

As part of this course, students …

- apply their knowledge of mathematics to analyze simple electronic circuits. [a]
- demonstrate an ability to utilize basic laboratory equipment and procedures. [b, k]
- engage in both formal and informal written and oral professional communication exercises. [g]
- utilize their earlier coursework and acquired expertise to complete a team-based major design project. [c, d, e, k]

The letters in brackets at the end of each statement identify the Student Outcomes to which that objective is contributing. The following Student Outcomes were approved in October 2010 for the BSEE and BSCmpE degree programs:

(a) an ability to apply knowledge of mathematics, science, and engineering

(b) an ability to design and conduct experiments, as well as to analyze and interpret data

(c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

(d) an ability to function on multidisciplinary teams

(e) an ability to identify, formulate, and solve engineering problems

(f) an understanding of professional and ethical responsibility

(g) an ability to communicate effectively

(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

(i) a recognition of the need for, and an ability to engage in life-long learning

(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Educational Outcomes describe students' expected knowledge and/or skills upon successful completion of the course. They are derived from the course educational objectives and measured by the students' performance against specific criteria for the course. Educational Outcomes typically include action verbs (e.g., "analyze," "demonstrate," "describe," or "design") and should be written as the conclusion to the statement, "Upon successful completion of this course, students should be able to …". Examples of appropriate course educational outcomes include the following:

Upon successful completion of this course, students should be able to …

- perform signed and unsigned addition and subtraction, observing errors.
- analyze signals in terms of their frequency content.
- design discrete single-stage amplifiers using BJTs and MOSFETs.
- write laboratory reports and documentation conforming to technical writing standards.