Academic Policies and Procedures Committees
PROPOSAL FORM -- Part A

○ Graduate AP&P ○ Undergraduate AP&P ◉ Both (Dual-Listed Courses) Submit simultaneously	Department/Program Proposal # GU_FAA_STBE_2018_03 Proposed Effective Date: FALL (year) 2019

College/Unit F&A Assoc. Dean Dewey Proposer(s) Ferrell

Department/Program STBE/Sustainable Technology Chair Raichle

1. I want to: Add (Complete Part A and B) Course Briefly describe the action(s) requested:

In the Undergraduate Bulletin, add a new course: TEC 4610: Photovoltaics II.

In the Graduate Bulletin add the course TEC 5610: Photovoltaics II.

2. Rationale for this request:

A sequence of photovoltaics courses has been developed to replace TEC 4608, which was a survey of photovoltaic technologies. This proposed course is the second course in the sequence and focuses on battery-based or stand-alone PV systems. The subsequent course will be Photovoltaics III, which will be offered as Selected Topics for another year before being added to the Bulletin.

3. a. List the current catalog copy (attach separate sheet if more space needed.)

N/A

b. List the proposed catalog copy (attach separate sheet if more space needed.)

See Attached.

c. Other REQUIRED attachments: see ***General Instructions***

4. List the committees, councils, and other groups that have considered this proposal; the action taken; and the date that action was taken.

Area	Action			Date of Action m/d/yyyy
	approved	not approved	not applicable	
Department/Program Faculty (undergraduate)	☑	☐	☐	11/13/2018
Department Graduate Faculty (graduate)	☑	☐	☐	11/13/2018
College Council(s)	☑	☐	☐	12/13/18
General Education Council	☐	☐	☑	
Council on Professional Education	☐	☐	☑	
Honors Council	☐	☐	☑	
Undergraduate Academic Policies & Procedures Committee	☐	☐	☐	2/6/19
Graduate Academic Policies & Procedures Committee	☐	☐	☐	2/18/19

5. Contact the Registrar's Office and (if applicable) Graduate School

Area	Person Contacted Includng Title	Response	Date of Response m/d/yyyy
Registrar's Office	Eric Berry	supports	11/19/18
Graduate School			

6. a. Please search the current online bulletin for courses and programs of study affected by this proposed change, including any in your own department. List each course and program in the appropriate table below or, if applicable, choose none. Attach a separate spreadsheet if necessary. (Click here for instructions on searching Online Bulletin.)

Course(s) Affected (number & title)
None ☒

Program(s) Of Study Affected (program code & title)
None ☐
Sustainable Technology (BS_571A)
Appropriate Technology (MS_599B)

b. List all affected department chairs/program directors, including those from 6a as well as those whose programs may be impacted in ways other than listed above, who have been consulted in the development of this proposal and their response in support or opposition to the proposal.

Name	Department/Program	Response	Date of Response m/d/yyyy

7. Is this a cross-listed course in another department? yes ○ no ◉ n/a ○ *(If yes, list the cross-listed courses:)*

8. Is this a General Education course? yes ○ no ◉ n/a ○ *(If requesting new general education credit, attach a syllabus and submit Part C of the AP&P proposal form to the Office of General Education)*

9. Distance Education:

   a. Does this proposal affect a course or requirement of a Distance Education program? yes ○ no ◉ If yes, has Distance Education been consulted? yes ○ no ○ *If yes, list the **date**(s), **Distance Ed** contact person, and their **response** in support or opposition to this proposal:*

   b. Mode of delivery: fully online ○ site-based ◉

   If you are not sure, contact the Office of Distance Education.

10. Schedule Type for new courses: Lecture/Lab Combo

Academic Policies and Procedures Committees
PROPOSAL FORM -- Part B (For additions only)

SELECT ONE: Course ◉ Certificate ○ Concentration ○ Minor ○ Degree ○

1. If this is a new course,

   a. Has it been offered as Selected Topics in the last five years? yes ◉ no ○ If so, how often and what were the enrollments each semester it was offered?

Spring 2018 enrollment: 17, Fall 2018 enrollment: 16, Spring 2019 enrollment: 16 (registration as of November 12, 2018)

   b. Are there courses from other departments that may cover or partially cover the subject matter of the proposed new course? yes ○ no ◉ n/a ○ *(If yes, list course numbers and titles:)*

2. Projected enrollment: 1st year 16 2nd year 16

3. Projected student clientele:

Sustainable Technology majors

4. Faculty:
   a. Additional faculty needed:

N/A

   b. Names of current faculty qualified to teach the course:

Brent Summerville, Jaewon Oh, Brian Raichle

   c. Other and continuing responsibilities of current faculty involved in new degree or course:

Faculty teaching this course will maintain their existing teaching, scholarship, and service duties.

5. a. For a new degree, attach the *Letter of Intent* submitted to UNC-System Office.

   b. For a new graduate certificate program, attach the *Proposing a New Graduate Certificate* form.

   c. For a new undergraduate certificate program, attach an explanation of the career and/or graduate education opportunities available to students.

6. List estimated costs of the new program or course that cannot be covered by the present budget:

N/A

7. Contact your department's Library Liaison. *List the date, person contacted, and their response.*
   (Click here for a list of Library Liaisons.)

John Boyd

8. Resource responsibilities: Has (have) the appropriate dean(s) been consulted in the development of this proposal? yes ◉ no ○ *If yes, list the date(s), name(s) and title(s) of person(s) contacted, and their response(s) in support or opposition to this proposal:*

Dean Kloda is aware of the development of a new photovoltaics sequence in the Sustainable Technology program.

9. For a new degree or certificate only, consult Institutional Research, Assessment, and Planning (IRAP) to develop functional learning goals and outcomes. Attach the goals and outcomes to be published on IRAP's website. List the date, person contacted, and their response. Examples of outcomes are found here.

N/A

TEC 4609 - Photovoltaics II (3)

When offered: Fall; Spring

Battery-based photovoltaic (PV) systems are used in a wide variety of applications including off-grid homes, small standalone lighting systems, back-up power systems at remote telecommunications sites, village micro-grid systems, and PV powered RVs and boats. This course focuses on components utilized in battery-based systems, including PV panels/arrays, batteries, charge controllers, generators, inverters, and inverter/chargers; and examines how they are integrated and configured for different applications. This design-based course focuses on detailed system sizing calculations, equipment selection criteria, and strategies for all types of battery-based PV systems. Lecture two hours, laboratory two hours.

Prerequisites: TEC 3609

[Dual-listed with TEC 5607.] Dual-listed courses require senior standing.

TEC 5609 - Photovoltaics II (3)

When offered: Fall; Spring

Battery-based photovoltaic (PV) systems are used in a wide variety of applications including off-grid homes, small standalone lighting systems, back-up power systems at remote telecommunications sites, village micro-grid systems, and PV powered RVs and boats. This course focuses on components utilized in battery-based systems, including PV panels/arrays, batteries, charge controllers, generators, inverters, and inverter/chargers; and examines how they are integrated and configured for different applications. This design-based course focuses on detailed system sizing calculations, equipment selection criteria, and strategies for all types of battery-based PV systems. Content mastery and applied practice at the graduate level is expected. Lecture two hours, laboratory two hours.

[Dual-listed with TEC 4607.]

DEPARTMENT OF SUSTAINABLE TECHNOLOGY & the BUILT ENVIRONMENT
APPALACHIAN STATE UNIVERSITY – *FALL 2019*

Course Number:	TEC4610- 101	**Title:**	Photovoltaics II
Credit Hours:	3	**Time:**	MW 12:00 pm - 1:50 pm
Instructor:	Brent Summerville	**Room:**	Kerr Scott 178
Office:	152 Kerr Scott Hall	**e-mail:**	summervilleb@appstate.edu
Office Hours:	Posted on door	**Phone:**	office (828) 262-7243, mobile (828) 773-9242

Required Text: Various resources and articles posted on ASULearn
Optional Text: Solar Energy International: *Photovoltaics: Design and Installation Manual*

Course Description:
Battery-based photovoltaic (PV) systems are used in a wide variety of applications including off-grid homes, small standalone lighting systems, back-up power systems at remote telecommunications sites, village micro-grid systems, and PV powered RVs and boats. This course focuses on components utilized in battery-based systems, including PV panels/arrays, batteries, charge controllers, generators, inverters, and inverter/chargers; and examines how they are integrated and configured for different applications. This design-based course focuses on detailed system sizing calculations, equipment selection criteria, and strategies for all types of battery-based PV systems. Content mastery and applied practice at the graduate level is expected. Lecture two hours, laboratory two hours.

Course Objectives: After completing this course, you should be able to:

System types [1.1]
- Identify and describe the basic functions of each component in a PV system
- Describe the configuration of various types of PV systems: PV direct, Stand–alone, PV/hybrid, Multimode, Zero-sell, Micro-grid, Utility-scale energy storage

Loads [1.1, 1.2, 1.3]
- Evaluate the electrical requirements of loads
- Identify loads with a duty cycle
- Identify phantom loads
- Estimate starting surge requirements
- Explain the relationship between real power, apparent power, and reactive power
- Perform basic power factor calculations
- Complete a load estimate for different system types and for seasonal loads
- Identify variables of DC-only load analysis

DC systems [1.1, 1.2, 2.1, 2.2, 3.1, 3.2]
- Define advantages and disadvantages of DC-only systems
- Identify design parameters for a mobile recreational vehicle (RV) application
- Size and integrate components of an RV application
- Size and integrate components of an DC lighting application

Off-grid System design [1.1, 1.2, 2.1, 2.2, 3.1, 3.2]
- Gather peak sun hour (PSH) data for a given location and array configuration
- Size and choose proper components of battery-based PV system based on loads
- Examine metering and programming diagram the completed system

Batteries [1.1, 1.2, 1.3, 2.1]
- Define the purpose of a battery
- List ways to compare battery technologies
- Describe different types of battery technologies
- Define basic lead-acid battery terms
- Describe the construction of a lead-acid battery
- Find the capacity & voltage of different batteries
- Determine the state of charge of a battery
- List safety precautions & equipment required to work with batteries
- Describe safe procedures for connecting and disconnecting batteries
- Describe the process of and purpose for adding water to batteries
- Identify appropriate battery enclosures
- List the characteristics of series circuits and parallel circuits
- Diagram a battery bank in series and parallel configurations, given system parameters
- Calculate values for current, voltage, power, and energy for different array and battery bank configurations

- Describe how different factors affect the lifecycle of lead acid batteries
- Account for temperature effects on batteries
- Design the battery bank for a system
- Calculate maximum charge rates for batteries
- Identify the components that control battery SOC in different PV system configurations
- Define when and why equalization is needed
- Identify common causes of battery problems and how to avoid them

Charging Batteries [1.1, 1.2]

- Explain the difference between bulk, absorption, float, and equalization cycles
- Describe how maximum power point tracking and voltage step-down affect a PV system
- Define sizing variables and how they affect design with MPPT and Non-MPPT charge controllers
- Examine the calculations for PV array and charge controller sizing with MPPT and Non-MPPT charge controllers
- List some features, options, and metering available on different types of battery chargers

Inverters [1.1, 1.2]

- Identify appropriate inverter types for different battery-based system configurations
- Compare available features and capabilities of battery-based inverters
- Identify specifications critical for choosing appropriate battery-based inverters
- Specify a stand-alone inverter given electrical load and surge requirements
- Describe various configurations for stacking and clustering multiple inverters
- Examine inverter/charger size considerations

Installation and Commissioning [1.1, 1.2]

- Describe when and why breakers would be used rather than fuses
- Label a 3-line diagram with grounding and disconnect terminology
- List the order of safe installation
- List the order of safe commissioning
- Review general start up procedures
- Identify basic set points and parameters
- Identify an order of shut-down and how to establish an electrically safe working environment
- Define recommended maintenance procedures

Generators [1.1, 1.2]

- Compare generator types and duty cycle ratings
- Evaluate different fuel options and chassis designs
- Examine starter options and generator enclosure types
- List routine maintenance tasks for generators
- Examine factors for specifying a generator for a PV/generator hybrid system

References in brackets refer to the Sustainable Technology Student Learning Outcomes (SLOs) found at:
https://irap.appstate.edu/institutional-effectiveness/student-learning-outcomes

Method of teaching: Lectures, presentations, discussions, films, field trips, assignments, and laboratory activities

Course Requirements:

- Complete assigned readings;
- Participate in class activities, discussions, and field trips;
- Complete individual projects;
- Attend class (see policy below); and,
- Complete and submit all assignments.

COURSE REQUIREMENTS AND METHODS OF EVALUATION

Field trips:
Field trips may include site visits to locations with battery-based PV systems or to perform site assessments and/or installation work.

Practical Midterm: The midterm will be a small group installation of a DC lighting system. Each group will be graded on the quality of their hands-on work using a rubric.

Final exam presentations:
During the final exam period, students will deliver an oral presentation on their individual off-grid residence design projects.
According to the Registrar exam schedule at:
https://registrar.appstate.edu/sites/registrar.appstate.edu/files/asu_fall_2018_exam_schedule_final.pdf
the final exam will be **Monday, Dec. 10, 2019, 11:00 am - 1:30 pm, KHH 178**

Class Projects: You will be assigned two battery-based PV design projects: one DC-only system (e.g. lighting, RV, boat) and one off-grid residence.

Assignments:
Assignments are expected to be turned in on the due date. Late work will be penalized one point per day late and will not be accepted for credit after four class periods. Assignments will sometimes be completed in class but may also involve completing work outside of class.

Quizzes: Online quizzes will be posted for a period of time. Once closed, the quiz cannot be made up.

Evaluation:

Class Assignments	20%
Quizzes	20%
Midterm (practical)	20%
Two Projects	20%
Final presentation	20%

Grading Scale:

93.0 – 100	A	73.0 – 76.9	C
90.0 – 92.9	A-	70.0 – 72.9	C-
87.0 – 89.9	B+	67.0 – 69.9	D+
83.0 – 86.9	B	65.0 – 66.9	D
80.0 – 82.9	B-	0 – 64.9	F
77.0 – 79.9	C+		

Attendance Policy: It is essential for your own satisfactory performance in the class that you do not miss classes. ***Every absence over 2 will reduce your final average by 2 points.*** Absences alone will not cause your grade to drop below a C-. I take attendance at the beginning of class so if you are not present you will be marked as late.

If you have a legitimate reason for missing a class such as an academic conflict, illness or family concerns, you must let me know in advance by e-mail. In case of emergencies I will accept a valid excuse given after the absence. You are responsible for any material covered, and for obtaining assignments and other materials for classes from which you are absent. Instead of asking me what you missed, please check ASULearn.

Cell Phones: Cell phones must be **on silent** during class; do not abuse phone use in class.

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DEPARTMENT OF SUSTAINABLE TECHNOLOGY & the BUILT ENVIRONMENT
APPALACHIAN STATE UNIVERSITY – *FALL 2019*

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