ECE 8260: SOLAR CELLS

ECE 8260 Section 001, Section 400 & Section 843

SPRING 2023

JANUARY 9, 2023

MEETING TIME: T, TH: 3.30 PM to 4.45 PM

MEETING LOCATION: Riggs 223

INSTRUCTOR: Dr. Rajendra Singh, srajend@clemson.edu, Mobile: 864-710-1311, Office: Riggs 206

TEACHING ASSISTANT: No TA

ZOOM LINK FOR CLASS:

https://clemson.zoom.us/j/97823584264?pwd=eVA2cS9YL01MY0pzODlCQXg3dGgzQT09

Meeting ID: 978 2358 4264

Pass Code: 044201

OFFICE HOURS AND PROCEDURES: Send e-mail or text me to set up time to meet on line. Exclusively, I have set up M, W, and F (1 PM-3 PM) as office Hours. However, if these hours do not suit you, contact me to set up some other time. To connect with me (other than class hours) use following zoom link:

https://clemson.zoom.us/j/3885930845

Keep this zoom link handy and always use to connect with me. You can always communicate with e-mail or text message.

COURSE MODALITY: Traditional

COURSE DESCRIPTION: To provide fundamental knowledge about generating green solar electricity by the use of solar cells. Special attention will be paid to demonstrate the potential role of photovoltaic systems as green and sustainable electricity generation source for current and future generations of humankind. The importance of DC Electricity generated by solar cells as the source of paradigm shift in global electricity infrastructure will be covered.

Topics to be covered:

Importance of Solar Electricity as Clean & Sustainable Energy
Fundamentals of Solar Energy (concept of trackers and concentration included)
Operating principles and design of photovoltaic (PV) Devices
Processing and manufacturing of photovoltaic Modules

Micro Inverters, Smart Inverters and Balance of System
Design, sizing and sub-systems of PV system
Operating principles, design and Limitations of hybrid photovoltaic/thermal systems
Batteries and capacitor based electrical energy storage systems
Smart grid, Micro Grid, Nano Grid and PV systems
Urban and rural applications of PV Electricity
Financing and Cost Estimation of Solar Electricity
Energy Policy and PV Electricity
Importance of DC Electricity in Global Electricity Infrastructure
PV for Electrification of Transportation
Solving Water Problem by Photovoltaics Generated Electric Power
Eradication of Global Poverty by PV electricity

COURSE PREREQUISITES: Permission of Instructor

STUDENT LEARNING OUTCOMES: At the completion of the course, students should be able to

Upon completion of this course, students should be able to:
1. Analyze fundamental requirements to build clean electric power infrastructure based on solar energy as free fuel
2. Operating principle of solar cells
3. Manufacturing of solar cells and Photovoltaic modules
4. Describe the technologies for storage of PV generated electric power
5. Design of Photovoltaic System based on PV Modules and Batteries for storing electric power
6. PV and batteries based nanogrids, microgrids and central grids
6. Transformative role of PV electric power in solving climate challenges and providing mobility solution and Power for Desalination
7. Access of Electric power to all

REQUIRED MATERIALS: No textbook. Class notes will be provided

The student is required to have a laptop computer, internet connectivity capable of transmitting and receiving video, a video camera, a microphone, and a cell phone.

TOPICs TO BE COVERED:

Importance of Free Fuel Based Solar Electricity as Clean & Sustainable Electrical Power
Fundamentals of Solar Energy (concept of trackers and concentration included)
Operating principles and design of photovoltaic (PV) Devices
Processing and manufacturing of photovoltaic Modules
Micro Inverters, Smart Inverters and Balance of System
Design, sizing and sub-systems of PV system
Operating principles design of hybrid photovoltaic/thermal systems
Batteries and capacitor based electrical energy storage systems
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CLASS CANCELLATION POLICY: Class is cancelled if the instructor is more than 15 minutes late to start the class.

GRADING POLICY:

ECE 8260 Grading Policy: Final grade for this course will be determined by following procedure:

Tests (2) : 30%
Homework: 15%
Research Project (individual research) : 40 %
Final Exam : 15 %
A= 90-100; B= 80-89; C= 70-79; F= 0-69

TEST AND FINAL EXAM DATES:

Test 1: March 2, 2023 (In class time)
Test 2: April 13, 2022 (in class time)

Final Exam (As per University Schedule): May 5, 2022: 11.30 AM- 2.00 PM

RESEARCH PROJECT: Photovoltaics generated electrical power represent the lowest cost , In addition battery storage cost is reducing. Thus, it is possible to provide electrical power to every one at a very low-cost. Depending on your focus area, each student will select their own individual topic and get approval from the instructor. All communications will be through e-mail. Do not send PDF files. Submit only word files. More details will be provided in the class.

ATTENDANCE POLICY: 1. Attendance is mandatory. If for some genuine reason (e.g. sickness, job/internship interview etc.) you cannot attend the class, please send me e-mail before the class that you will not be able to attend the class due to a particular reason. All students are required to attend the first scheduled day of class. Students who cannot attend the first class are responsible for contacting me to indicate their intent to remain in that class. If you do not attend the first class meeting or contact me by the second-class meeting or the last day to add the class, whichever comes first, I have the option of dropping you from the roll.
2. All tests will be given only during class time. If on any test day class is canceled, alternate date will be used during class time.
3. A copy of class notes, power point files etc. will be distributed to the class.
4. Canvas will be used for posting course related material.
5. Every attempt will be made to record the lectures and post on Canvas.

ACCESSIBILITY STATEMENT: Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to a class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by

calling 864-656-6848 or by emailing studentaccess@lists.clemson.edu. Students who receive Academic Access Letters are strongly encouraged to request, obtain, and present these to their instructors as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process each semester. You can access further information here: http://www.clemson.edu/campus-life/campus-services/sds/.

TITLE IX STATEMENT: Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability, veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972.

SAFE CAMPUS: Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

a. Ensure you are signed up for emergency alerts (https://www.getrave.com/login/clemson)
b. Download the Rave Guardian app to your phone (https://www.clemson.edu/cusafety/cupd/rave-guardian/)
c. Learn what you can do to prepare yourself in the event of an active threat (http://www.clemson.edu/cusafety/EmergencyManagement/)

ACADEMIC INTEGRITY: As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately to charges of violations of academic integrity. Further information on Academic Integrity can be found in the *Graduate School Policy Handbook*.

COPYRIGHT STATEMENT: Materials in this course are copyrighted. They are intended for use only by students registered and enrolled in this course and only for instructional activities associated with and for the duration of the course. They may not be retained in another medium or disseminated further. They are provided in compliance with the provisions of the Teach Act. Students should be reminded to refer to the Use of Copyrighted Materials and "Fair Use Guidelines" policy in on the Clemson University website for additional information: https://clemson.libguides.com/copyright.

MODIFICATION STATEMENT: The instructor reserves the right to modify any aspect of the syllabus at any time during the semester for reasons including but not limited to COVID-related situations. This syllabus was posted on January 9, 2023.

ADDITIONAL INFORMATION: 1. All tests and final exam will be on line
2. Procedures for turning in homework online will be provided in Canvas announcements.
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