ETEC 3340 01 Solar & Wind Energy Systems (3 cr. Hrs, 4-contact Hrs.**)**
MW: 3:00 – 4:50 PM PETC 220

Instructor: Dr. Reg Pecen, Quanta Endowed Professor
Office: PETC 420D @ 936-294-4137 e-mail: regpecen@shsu.edu
Office Hours: TTh: 11:00-11:50 AM and 3:00 – 5:00 PM
(*You can also call or e-mail me and arrange extra office hours by appointment*).

Textbook: *Photovoltaic Systems 3rd Edition,* James P. Dunlop, in Partnership with NJATC, American Technical Publishers (ATP), 2012. ISBN: 978-0826992277.

Reference Books:

- *Wind Turbine Technology, Ahmad Hemami,* Cengage learning Series in renewable Energies, ISBN-13: 978-1435486461 *(available to be used in the Lab Curriculum).*
- *Introduction to Wind Principles*, Thomas E. Kissell, Prentice Hall, 2011, ISBN 10: 0132125331, ISBN 13: 9780132125338.
- *Alternative Energy Systems & Applications*, B.K. Hodge, Wiley Publication, 2010, ISBN: 9780470142509.
- *Alternative Energy Systems in Building Design*, Peter Gevorkian, McGraw-Hill, 2010, ISBN: 9780071621472.
- *Electric Energy: An Introduction 2nd Ed.*, Mohamed A. El-Sharkawi, CRC Press Taylor & Francis Group, 2010, ISBN: 9781420062199.

Course Catalog Description: This course will examine grid-connected and stand-alone solar photovoltaic and wind energy systems. System components including batteries, PV modules, charge controllers, maximum power point trackers, vertical and horizontal axis turbines, aerodynamics of wind turbines, wind farms and sighting, and inverters will be discussed. A comprehensive review of power production methods from solar and wind resources will be included, along with site surveying, commercial development, economics and environmental impacts.
Prerequisite: ETEE 1340 and Junior Standing.

Course Objectives:

Energy systems play a critical role in everyday life, and as such are an important part of engineering and technology. This course serves as an introductory course in alternative energy with emphasis on energy harvesting, conversion, and storage systems. This course will be a combination of lecture, demonstrations, student inquiry, in-class problem solving, and hands-on lab projects. The students will be required to complete a series of exercises/ lab projects and/or tests that will reflect their knowledge of the stated objectives. This course is intended to develop an understanding of wind energy with respect to environmental, economic, technical, and political issues. It also promotes the value of increased use of wind energy and related research, development, and manufacturing for nation's energy independence efforts.

This type of course is becoming essential part of engineering and engineering/industrial technology program curricula with variety of job opportunities. Because students graduate from these programs may be involved in at least buying, managing, and or trading alternative energies during their careers as part of their jobs requirements. It is essential that students at least needs to be familiar with solar, wind as well as hybrid energy sources and
their applications. The course concludes with a general review of how to integrate energy harvesting technologies into a system providing a continuous uninterrupted power stream. The wind portion of the course includes the following; fundamentals of wind power, history of wind energy, characteristics of wind, measurement and siting of individual wind turbines and wind farms; operation, control, applications and types of wind turbines. The class also includes stand alone, grid-tie (connectivity), transmission, economic and management issues, instrumentation and data acquisition systems of wind and solar PV systems.

Course Learning Outcomes:
Both PVs and wind energy systems are rapidly integrating to both stand-alone and grid-tied power systems. It is a growing sector of the energy market. Your basic DC & AC circuits background is important to understand the PV and wind energy systems.

- The first objective of this course is to learn the fundamental electrical and electronics principles of PVs and wind turbines/generators and how to effectively incorporate PV and wind power systems into stand-alone or grid-interconnected power systems.
- The second objective is to understand the constraints imposed on the voltage, current, and power when PV modules are connected in multiple arrays as series and/or parallel. Similarly, connecting to stand-alone or synchronization of wind generators to the grid is to be examined.
- The third objective is to learn site evaluation, component operations, system design and sizing, installation requirements and recommended practices.
- The last objective of the course will be maintaining, servicing, and troubleshooting solar and wind power systems for safe and effective operation.

Computer Software Tool: FESTO Grid-Tied Solar-Wind Simulator will be introduced in the class. National Instruments (NI) MultiSim version 10.1 can be used to model and simulate PV and wind generators.

Class Structure and Attendance: This is an important ECET major class and your attendance is highly encouraged. Lectures, laboratory experimental projects, homework assignments, and quizzes will constitute the structure of the course. The make-up labs and exams will be given only in the case of **documented physical illness** (**In this case, students must inform instructor at least 24 hours before the exam**). *There will be no make-up option if you are not in the class during the pop-quiz time.*

Homework & Lab Assignments: Homework assignments will be collected and graded regularly. No credit will be given for late homework assignments (except documented physical illness). Students are encouraged to work and discuss with others on the lab reports and homework

assignments, however, submissions must consist of the students own work, in accordance with departmental policies. Please work neatly, showing all calculations, manipulations, plots and program files (if any) required reaching your solution. No separate research and design project will be assigned in this course, since lab experiments will also cover design content.

- Students are encouraged to work and discuss with others on the lab reports and homework assignments, however, submissions must consist of the students own work, in accordance with departmental policies. Please work neatly, showing all calculations, manipulations, plots, and simulation program files (if any) required reaching your solution.

Classroom Rules of Conduct: Students will avoid doing behavior in the classroom that intentionally or unintentionally disrupts the learning process and, thus, obstructs the mission of the university. Cellular telephones and pagers must be turned off before class begins. The use of cell phones or other electronic devices is prohibited without permission of the instructor. Students are prohibited from eating in class, using tobacco products, making offensive remarks, reading newspapers, sleeping, talking at inappropriate times, or engaging in any other form of distraction. Inappropriate behavior in the classroom shall result in a directive to leave class. One warning will be given for a violation and all additional violations will result in a one letter grade reduction. If academic dishonesty is suspected, the student will be reported to the Dean of Students for disciplinary action in accordance with university policy.

Contribution of the course to meet the requirement of ABET (General) Criterion 5:

- This course provides the prerequisite foundation of knowledge necessary for understanding AC electrical circuits and introduction to circuits and systems. Circuit analysis that constitutes the main pillars of

Program Outcomes Supported by Course Objectives http://www.shsu.edu

Directly supported ECET program outcomes:

Analyze, design, simulate electrical and electronic components, circuits, and systems. (1).

Students will be capable of applying creativity in the design of components and systems based on specified requirements and known design techniques (4).

Design and carry out experiments (5).

Have knowledge of fundamental principles of science and mathematics and apply them to solve practical problems of engineering technology (6).

Collaborate in laboratory and classroom to work effectively in teams (9).

Indirectly supported ECET program outcomes:

Students will apply project management techniques to analyze and manage the progress of electrical, electronic system design and development projects (7).

Produce clear, precise and effective technical documents and oral presentations with the help of modern information technologies (8).

Student will have knowledge of quality and continuous improvement, and can manage their project involvement, demonstrating project and time management skills and leadership on individual and team projects (10).

Grading: The final grade will be based on the following requirements.

Mid-term Exam	**25%**
Final Exam	**25%**
Laboratory Experimental Projects (8 Lab Sessions)	**15%**
Homework Assignments (10 assignments)	**15%**
Attendance, Participation, Attitude	**10%**
Quizzes (Min 7)	**10%**
Total	**100%**

Percentage Range	Letter Grade
90 – 100	A
80 – 89	B
70 – 79	C
60– 69	D
0-59	F

Course Content and Lab Schedule: The tentative course content and lab schedule will include the following topics. Depending upon extra handouts/simulations/homework assignment explanations, ***the following tentative course content may be shifted slightly***.

		ETEE 2320 - Fall 2017	
Week	**Date**	**Subject**	**Readings- Assignments- Resources**
1	8/23	Introduction to the course; Syllabus Review, **Ch.1** Introduction to Photovoltaic Systems *(also briefly covers Wind Power)* **Ch.2** Solar Radiation **HW#1 (Due 8/30)**	Textbook pp. 1-59
2	8/28 – 8/30	**Ch. 3** Site Surveys and Preplanning **Ch. 4** System Components and Configurations **HW#2 (Due 9/6)**	Textbook pp. 61- 121
3	**9/4** – 9/6	Monday: Labor day Holiday NO Classes Wednesday: **Ch. 5** Cells, Modules, and Arrays	Textbook pp. 123 -156
4	9/11 - 9/13	**Ch. 6** Batteries **HW#3 (Due 9/20)** **Ch. 7** Charge Controllers	Textbook pp. 159-183 Textbook pp. 187-213
5	9/18 - 9/20	**Ch. 8** Inverters **HW#4 (Due 9/27)** ***Lab #1*** *SolarWind_System (Components, Safety Procedure, Lackout-Tagout, Grounding)*	Textbook pp 217-245 Lab#1 SolarWindSystem Lab #1 Report Due
6	9/25 - 9/27	**Ch. 9** System Sizing **Ch. 10** Mechanical Integration **Ch. 11** Electrical Integration **HW#5 (Due 10/4)**	Textbook pp 247-271

7	10/2 – 10/4	Ch 12 Utility Interconnection ***Lab#2*** *Solar_Module (Installing solar module, charge cont., battery bank, loads)*	Textbook pp 275-373 *Lab#2 Solar_Module* Lab# 2 Report Due
8	10/9 – 10/11	***Mid-Term Test (Chapters 1-12)*** Ch 13 (H) Intro to Wind Energy: Importance of Wind Energy for TX and the U.S.A.	**Midterm Test, Monday, October 9** Ch. 1-12 **Handouts "H"**
9	10/16 – 10/18	Ch 14 (H) History of Wind Energy and Wind Turbines, Energy & Power Fundamentals **HW#6 (Due 10/25)** ***Lab #3*** *Wind_Module (Wind Turbine connection & Operation with safety features)*	Handouts *Lab #3 Wind_Module* Lab#3 Report Due
10	10/23 – 10/25	Ch 15 (H) Wind Characteristics & Wind Resource **HW#7 (Due 11/1)** ***Lab#4*** *SolarWind_DivisionLoadController (Division Load and Controller to harness and excel alternative energy once the battery fully charged)*	*Handouts* *Lab#4 SolarWind_Division LoadController* Lab #4 Report Due
11	10/30 – 11/1	Ch 16 (wind) Wind Turbines and Energy Production **HW#8 (Due 11/8)** ***Lab #5*** *SolarWind_EnergyEfficieny (Efficiency of several components of the SolarWind Trainer and Energy Conservation)*	Handouts Lab #5 SolarWind_EnergyEfficieny Lab #5 Report Due
12	11/6 – 11/8	Ch 17 (H) Large & Small Scale Wind Turbines & Farms **HW#9 (Due 11/15)** ***Lab #6*** SolarWind_PowerTransmissionDistribution (How to distribute power safely and effectively by connecting various loads to AC power load center)	Handouts Lab #6 SolarWind_Power TransmissionDistribution Lab #6 Report Due
13	11/13 – 11/15	***Lab #7*** *Hybrid_Generator (Installing and operating a solar and wind hybrid electrical power system to deliver alternative energy more effectively)*	Lab#7 *Hybrid_Generator* Lab #7 Report Due
14	11/20 – **11/22**	***Lab # 8*** *Grid-Tied_System Simulator (Digital Simulation of Grid-Tied Solar and Wind Power Systems)* ***Thanksgiving Holiday- No Class on Nov 22, 2017***	*Lab # 8 Grid-Tied_System Simulator* Lab #8 Report Due
15	11/27 – 11/29	MakeUp Chapters; Chapter Reviews Final Exam Review (Thursday, 11/29)	
16	12/4 – 12/7 Finals Week	**Final Exam; Monday, December 4, 2017 @6:00-8:00 PM Chapters: All**	*Wishes best luck*

Laboratory Assignments: There are regular labs indicated on the class schedule. All laboratory project assignments must be completed for your lab grading. You must obey departmental laboratory safety rules & policies. ***You must attend and successfully complete the each lab.*** Lab reports due dates are provided in the tentative schedule. Make sure you write clearly and neatly! Please use the lab instruction handouts for your lab reports.
Note: *It is the student's responsibility to arrange make-up labs with the instructor. Make-up labs may be considered with a report proven medical reason.*

Lab Submission Procedure:
Use the provided lab handouts or tear off the related pages from the laboratory workbook and staple them together before submitting to the instructor. When staple the lab experiments please staple each lab separately.

Rules and Recommendations for Effective and Safe Use of the Laboratory and Work Benches in PETC 210C Laboratory

1. ***DO NOT turn on the power before the instructor checks your circuit!***

2. Use the coat racks for neat laboratory appearance as well as safety. Do not place coats or book bags on workbenches.

3. Refrain from drinking beverages in the laboratory. The hall may be used for intervals of relaxation.

4. ***The lab bench must be cleaned and all wires must be returned to the hooks provided in the lab room before leaving the room.***

5. Report all component and equipment failures to your Instructor lab TA. Neglecting to report faulty equipment causes problems for the next group that uses the bench and may result in injuries.

6. When using the instruments ***DO NOT STACK THEM,*** as the combined heat may cause component failure.

7. Place all of the trainer units, transformers, motors, DMMs, resistors, inductors, capacitors, etc., back to their original places and/or *original rated* boxes after you are done with the laboratory.

8. ***All power switches should be turned off before leaving the lab bench.***

9. Rings and other jewelry, which may cause a potential hazard, must be removed before working in the laboratory.

10. No individual should operate equipment in the laboratory until the appropriate examinations are passed and/or demonstrations by instructor are safely observed.

I encourage you to utilize the Professional and Academic Center for Excellence (PACE)'s **free assistance with writing, math, science, reading, and learning strategies**. The PACE is dedicated to providing

professional development for administration, faculty, staff, and students. Using programs and services founded on evidence-based teaching and leadership strategies, our ultimate goal is effective student learning and development. Please contact; CHSS Room C002 or e-mail: PACE@shsu.edu; Tel: 936-294-2688

General Safety Procedures – Introduced by the instructor	
I. Introduction: How Electricity Works a. Conductors b. Insulators c. Grounding	**II. Hazards of Electricity** a. Electrical shock b. Electrical burns c. Electrical fires d. Case Studies of Electrical Accidents
III. Types of Electrical Hazards a. Working on energized (hot) circuits b. Loose connections c. Frayed or missing insulation d. Missing ground prongs on plugs e. Water and electricity don't mix f. Damaged power tools g. Ungrounded equipment h. Improper use of extension cords	**IV. How to Protect Yourself from Electricity** a. General electrical safety rules b. Properly grounded electrical circuits c. Ground fault protection near water sources d. Insulated power tools e. Proper housekeeping f. Don't overload circuits
V. Soldering Hazards a. General soldering safety rules b. Proper handling of soldering equipment	

Academic Dishonesty: All students are expected to engage in all academic pursuits in a manner that is above reproach. Students are expected to maintain honesty and integrity in the academic experiences both in and out of the classroom. Any student found guilty of dishonesty in any phase of academic work will be subject to disciplinary action. The University and its official representatives may initiate disciplinary proceedings against a student accused of any form of academic dishonesty including but not limited to, cheating on an examination or other academic work which is to be submitted, plagiarism, collusion and the abuse of resource materials.

Student Absences on Religious Holy Days Policy: Section 51.911(b) of the Texas Education Code requires that an institution of higher education excuse a student from attending classes or other required activities, including examinations, for the observance of a religious holy day, including travel for that purpose. A student who is excused under this subsection may not be penalized for that absence and shall be allowed to take an examination or complete an assignment from which the student is excused within a reasonable time after the absence. University policy 861001 provides the procedures to be followed by the student and instructor. A student desiring to absent himself/herself from a scheduled class in order to observe (a) religious holy day(s) shall present to each instructor involved a written statement concerning the religious holy day(s). This request must be made in the first fifteen days of the semester or the first seven days of a summer

session in which the absence(s) will occur. The instructor will complete a form notifying the student of a reasonable timeframe in which the missed assignments and/or examinations are to be completed.

Services for Students with Disability (SSD): The mission of the Services for Students with Disabilities (SSD) is **to promote full and equal access on the part of students** with disabilities to educational and extracurricular programs and activities at SHSU.It is the policy of Sam Houston State University that individuals otherwise qualified shall not be excluded, solely by reason of their disability, from participation in any academic program of the university. Further, they shall not be denied the benefits of these programs nor shall they be subjected to discrimination. Students with disabilities that might affect their academic performance should register with the Office of Services for Students with Disabilities located in the Lee Drain Annex (telephone 936-294-3512, TDD 936-294-3786, and e-mail disability@shsu.edu). They should then make arrangements with their individual instructors so that appropriate strategies can be considered and helpful procedures can be developed to ensure that participation and achievement opportunities are not impaired.

SHSU adheres to all applicable federal, state, and local laws, regulations, and guidelines with respect to providing reasonable accommodations for students with disabilities. If you have a disability that may affect adversely your work in this class, then I encourage you to register with the SHSU Services for Students with Disabilities and to talk with me about how I can best help you. All disclosures of disabilities will be kept strictly confidential. NOTE: No accommodation can be made until you register with the Services for Students with Disabilities. For a complete listing of the university policy, see: http://www.shsu.edu/dept/academic-affairs/documents/aps/students/811006.pdf

Tobacco Policy: In order to promote a healthy, safe, and aesthetically pleasing work, educational, and living environment, Sam Houston State University (SHSU) will endorse a smoke-free and tobacco-free environment. The primary purpose of this policy is to establish guidelines prohibiting smoking and the use of all tobacco products. Tobacco products include cigarettes, cigars, pipes, smokeless tobacco, and all other tobacco products. This policy applies to all faculty, staff, students, employees of contractors, and visitors of SHSU on the premises of the university.

Visitors in the Classroom: Only registered students may attend class. Exceptions can be made on a case-by-case basis by the professor. In all cases, visitors must not present a disruption to the class by their attendance. Students wishing to audit a class must apply to do so through the Registrar's Office.

"The schedule, policies, labs, and assignments in this course are subject to change in the event of extenuating circumstances or by mutual agreement between the instructor and the students."
Please do not hesitate to ask help from instructor.