COURSE SYLLABUS FOR
MECH 433, SOLAR ENERGY ENGINEERING - 3 UNITS

California State University, Chico
Spring Semester 2017

Instructor:	Dr. G.A. Kallio, OCNL 417, 898-4959 email: *gkallio@csuchico.edu*
Office hours:	W 2-3:50pm, R 2-2:50pm
Class hours:	TR 9:30-10:20am (lecture), OCNL 254 F 2-3:50pm (activity), OCNL 254 and LANG 122
Catalog Description:	This introductory course covers the design and operation of solar photovoltaic (PV) and solar thermal systems. Foundational topics include solar radiation characteristics, solar materials, and heat transfer. Solar PV systems include cell operation, I-V characteristics, module design, maximum power-point tracking, charge controllers, batteries, inverters, design of grid-tied and off-grid systems, and system performance evaluation. Solar thermal systems include flat-plate collectors, concentrating collectors, solar water heating, solar space heating and cooling, and solar thermal power systems.
Prerequisites:	CIVL 321, Fluid Mechanics; MECH 332, Thermodynamics; EECE 211, Linear Circuits.
Corequisite:	MECH 338, Heat Transfer.
Primary Textbook:	***Solar Energy Engineering,*** Soteris A. Kalogirou, 2nd Edition, Academic Press (2013), ISBN: 9780123972705. Available as eBook in Library: Solar Energy Engineering - Kalogirou
Supplemental Textbook:	***Photovoltaic Systems,*** James P. Dunlop, 3rd Edition, American Technical Publishers (2012), ISBN: 9781935941057. Recommended for students seeking NABCEP certification.
Additional Resources:	***PV Education*** website: http://www.pveducation.org/pvcdrom ***Solar Energy,*** Andy Walker, John Wiley & Sons, (2013) ISBN: 9781118139240. Available as eBook in Library: Solar Energy - Walker ***Solar Engineering of Thermal Processes***, John A. Duffie and William A. Beckman, 4th Edition, Wiley (2013). Available as

eBook in Library: Solar Engineering of Thermal Processes - Duffie & Beckman

Photovoltaics: System Design and Practice, Heinrich Haberlin, Wiley (2012). Available as eBook in Library: Photovoltaics - Haberlin

Photovoltaics: Fundamentals, Technology and Practice, Konrad Mertens, Wiley (2014). Available as eBook in Library: Photovoltaics - Mertens

Software: ***EES: Engineering Equation Solver, PVWatts, Solar Pathfinder Assistant, Solmetric PV Designer***

Internet: Lecture slides, homework and solutions, lab and project descriptions, supplemental reading, and other course material are posted on Blackboard Learn.

Grading:

Class Exercises & Labs	15 %
Homework	20 %
Project	25 %
Midterm Exam	20 %
Final Exam	20 %

Homework: About four homework sets will be assigned during the semester. Problem solutions must be neat, legible, numbered, arranged in assigned order, written on only one side of the paper, and stapled.

Homework is due at the beginning of class on the due date. **Late homework is not accepted.**

Class Exercises: About four problem-solving class exercises will be assigned and completed during the Friday activity session.

Labs: There will be several labs scheduled for the Friday activity that cover PV electrical characteristics, solar irradiance measurement, solar site surveys, solar water heating, and possibly more.

Project: A project will be assigned to student teams based on individual interest from a project list. Student-proposed projects will also be considered. The projects will culminate with brief written reports and short class presentations. More information will follow.

Examinations: There will be one Midterm Exam and a Final Exam. The Final Exam will have emphasis on those topics covered after the last midterm exam. Exams will be closed-book but two, 8½" x 11" pages of notes (front & back) are allowed during the exams. The

Final Exam will be given on Tuesday, May 16, 12:00-1:50pm in OCNL 254.

If you know you are going to miss an exam due to illness or other legitimate reason, you must contact me before the exam. (You can call me at home on such occasions: 342-8640.) Make-up exams are only allowed for pre-arranged, legitimate absences.

Field Trips: Field trips to local solar businesses or solar installations are planned.

Guest Lectures: Engineers working in the solar energy industry will be invited to present guest lectures.

Email: If you need to contact me outside of class or office hours, please use email. It is expected that all students will monitor their Wildcat email accounts as I will use this system to make important announcements from time to time. You can set up automatic forwarding of your Wildcat email to a preferred email provider at http://www.csuchico.edu/itss/email/students/index.shtml .

Cell Phones: All alert sounds on your cell phone must be turned off during class. Cell phone use during class will not be tolerated, except for emergency situations (911).

Academic Integrity: Students are expected to be familiar with the University's Academic Integrity Policy. Your own commitment to learning, as evidenced by your enrollment at California State University, Chico, and the University's Academic Integrity Policy requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the Office of Student Judicial Affairs. The policy on academic integrity and other resources related to student conduct can be found at: http://www.csuchico.edu/sjd/integrity.shtml. Copying solutions from other sources is a form of plagiarism and punishable in accordance with the University Academic Integrity Policy.

Disability Services: If you need course adaptations or accommodations because of a disability or chronic illness, or if you need to make special arrangements in case the building must be evacuated, please see me during office hours as soon as possible. Students with disabilities requesting accommodations must register with the Accessibility Resource Center (ARC) to establish a record of their disability, as they are the designated department responsible for approving and coordinating reasonable accommodations and services for students with disabilities. ARC will help you understand your rights and responsibilities under the Americans with Disabilities Act and provide you further assistance with

requesting and arranging accommodations. Special accommodations for exams must be arranged with ARC well in advance of the exam date. Their email address and website are arcdept@csuchico.edu , http://www.csuchico.edu/arc.

Specific Course Outcomes - what a student should be able to do at the end of this course:

1. Calculate the terrestrial solar irradiance on an arbitrary tilted surface.
2. Identify and describe the basic instruments used to measure solar radiation.
3. Conduct a solar site survey using an appropriate instrument and software.
4. Understand the operation of a PV cell and module, and their I-V characteristics.
5. Understand the function of a charge controller, batteries, and inverter in a PV power system.
6. Predict actual power output from a solar PV module, accounting for incident irradiance, angle of incidence, and cell temperature.
7. Design a basic grid-tied solar PV power system.
8. Design a basic stand-alone (off-grid) solar PV power system.
9. Calculate efficiency and performance factors of grid-tied PV systems from monitored data.
10. Understand the interaction of solar radiation with opaque and transmissive materials: calculate solar absorption, reflection, and transmission energy rates.
11. Identify and quantify the important heat transfer modes (conduction, convection, radiation) in a solar energy system.
12. Use a flat plate solar collector mathematical model to predict performance.
13. Understand the different types of solar hot water and space heating systems.
14. Design a basic flat plate solar collector and water heating system.
15. Understand the different types of solar thermal power systems.