

BAEN 414/614, RENEWABLE ENERGY CONVERSIONS (Fall 2015)

Lecture: 2 hrs/week and Laboratory: 2 hrs/week

COURSE SYLLABUS

Course Description:

This course deals with the engineering and technical aspects of quantifying, designing and evaluating the suitability of several alternative and renewable energy conversion systems utilizing biomass, solar, wind, hydro power and others. This course will open new insights into the vast resources that future engineers and those in related disciplines can harness to augment diminishing supplies of man's non-renewable energy and power source. At the end of the course, the student should be able to identify the different sources of sustainable energy, fuel and power, know their applications, recognize their limitations, and demonstrate the capability to manage and design the energy and power systems.

Lecture Schedule: Tuesday and Thursday, 8 - 8:50 am Scoates 215

Laboratory Schedule: Wednesday, 1:50 – 3:40 pm AEPM 203

Textbook:

Capareda, S. C. 2014. Introduction to Biomass Energy Conversions. 1st Edition. CRC Press, Taylor and Francis Group, Boca Raton, FL. ISBN 978-1-4665-1333-4: TP339.C36 2013.

Suggested References:

1. Boyle, Godfrey. 2004. Renewable Energy: Power for a Sustainable Future. Oxford University Press, UK.
2. Duffie, J.A. and W. A. Beckman. 2006. Solar Engineering of Thermal Processes 3rd Edition. McGraw Hill Book Co, Inc., New York. **TJ 810 D82 2006**
3. Hiler, E.A. and B.A. Stout. 1985. Biomass Energy: A Monograph. Texas Engineering Experiment Station Monograph Series. Texas A&M University press, College Station, Texas. **TP360 B5875 1985**
4. Stout. B.A. 1984. Energy Use and Management in Agriculture. Breton Publishers, Belmont California. **S494.5 ES S673 1984**
5. Manwell, J.F., J.G. McGowan and A. L. Rogers. 2002. Wind Energy Explained: Theory, Design and Applications. John Wiley and Sons, Inc. New York. **TJ 820 M374 2002**
6. Kitani, Osamu and Carl W. Hall (eds). 1989. Biomass Handbook. Gordon and Breach Science Publishers. New York. **TP248 B55 B555 1989**
7. Kemp, W. H. 2006. Biodiesel: Basics and Beyond. Aztext Press. Ontario, Canada. **TP 359 B46 K44 2006**

Prerequisite: BAEN 320 (Engineering Thermodynamics), BAEN 366 (Transport Processes in Biological Systems) or Equivalent and Consent of Instructor.

Instructor:

Dr. Sergio Capareda Scoates 303D
Phone: 458-3028 E-mail: scapareda@tamu.edu
Consultation Hours: MWF: 8-12 Noon; T-TH: 1-5 pm

Teaching Assistant:

Nam Hyungseok Phone: To be provided upon request
E-mail: namhs219@gmail.com Consultation Hours: By appointment.

Learning Outcomes

At the end of this course, the student should be able to

1. Quantify available renewable energy resources (resource assessment)
2. Characterize the variability of renewable energy resources throughout a given site or season.
3. Calculate useful energy and power potential from each renewable energy resource (efficiency of conversions)
4. Design and evaluate specific renewable energy conversion systems as follows:
 - a. ethanol production from bio-resources,
 - b. bio-diesel production from vegetable oils and fats and algae lipids,
 - c. anaerobic digestion (biogas production) from co-digestion of animal manure,
 - d. pyrolysis and gasification for synthesis gas, bio-oil and biochar production
 - e. other alternative and renewable energy resources such as solar photovoltaic applications (PV) for electrical energy use and storage, solar still for potable water use; solar refrigerator, solar dryer and space heater; wind power generation systems; hydro power and geothermal energy systems, fuel cells, salinity gradient, wave and tidal energy, fusion technology and other alternative energy. The costs and environmental benefits of all the above technologies will also be discussed.

COURSE GRADING AND FORMAT

Grading:	Grad	Undergrad		
Exams (3)	60 %	60%	A	90 - 100 %
Laboratory Exercises	15 %	20%	B	80 - 89 %
Quizzes/Homework	15 %	20%	C	70 - 79 %
Term paper (grad)	<u>10%</u>		D	60 - 69 %
Total	100%	100%	F	<60 %

The final exam is optional for students with a passing pre-final score. For those taking the final exam, the final grade will be obtained as 60% of the pre-final score and 40% of final exam score.

Class Format:

This is a 2 hour lecture course followed by 2 hours of laboratory each week. There will be hands-on exercises for each type of renewable energy resource discussed. The laboratory work will also include technical calculations. Hand-outs and assigned chapters from the references list will be given. There will be homework and *case studies/projects for graduate students* under each renewable energy type.

Teams and Grade Distributions:

The laboratory exercises will be done as group work. Students will be divided into teams for this purpose. Graduate students will have advanced renewable energy problems and some individual projects. ***On homework, graduate students are normally assigned more problems than the undergraduate students. These additional homework problems are more involved and have advanced topics that the graduate students prepare and finish by doing additional readings from handouts and textbooks.*** All work collected for grading will have individual scores. Teams will have assigned seating in the classroom to assist in checking of attendance.

Exams:

Tentative dates for the three regular exams are given in the course schedule. The final dates will depend upon the pace of class lectures. Exams may include both problems to solve and short answer/multiple choice questions. ***Likewise, graduate students have to solve more problems than undergraduate students.*** Exams will be individual work and will be closed book and closed notes. Conversion tables, formulas and monographs will be provided for the exam. The final exam will be given as scheduled in the University Schedule. It will be a comprehensive exam.

Make-up Exams:

Make-up exams will be given only for those having a university excused absence (see Student Rules). Make-up exams will be scheduled by the instructor.

Laboratory Work

There will be laboratory exercises in all renewable energy areas discussed. Individual/group laboratory report is required with the *graduate students having more questions to answer at the end of the exercise handout*. The laboratory report will be submitted a week after the exercise was made. A format for report is provided in each laboratory exercise handout.

Safety in the Laboratory

Safety is the number one priority in the laboratory. Students are asked to read the laboratory safety guidelines concerning the exercises performed at the first laboratory meeting. They will be asked to sign the “**Student Safety Contract Agreement**” after reading the safety documents. This must be submitted to the instructor or TA before they are allowed to conduct experiments at the laboratory. In addition, each student has to do this certification electronically in Howdy.

Homework and Quizzes:

Problems will be assigned both for in-class completion and as homework. All homework will be collected and graded. No late homework will be accepted unless you have valid excuse. Unannounced quizzes will be given periodically. No make-up quizzes will be given. A quiz missed due to a university excused absence, will not be included in the calculation of the final grade.

Academic Integrity:

For many years, Aggies have followed a Code of Honor in an effort to unify the aims of all Aggies toward a high code of ethics and dignity. It functions as a symbol to all Aggies, promoting understanding and loyalty to truth and confidence in each other. Students should refer to the University policy on academic integrity found in the **Honor Council website**: <http://www.tamu.edu/aggiehonor/honorcouncil.php>. All violations will be handled as specified by University Guidelines.

Aggies do not lie, cheat or steal; nor do they tolerate those who do.

If you have any questions regarding plagiarism or cheating, please consult the Texas A&M University Student Rules, under the section Scholastic Dishonesty. These procedures will be followed and enforced in this course to maintain an environment of academic honesty.

Students with Disabilities

The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services in Cain Hall, Room B118, or call 845-1637. For additional information visit <http://disability.tamu.edu>.

Attendance:

Attendance will be taken during each class. It is the student's responsibility to learn the material and make up any assignments missed. In the event that a student must miss an exam, it is the student's responsibility to make arrangements to make the test up. Refer to the Texas A&M University Student Rules for any questions you have on attendance. *There are bonus points for having a complete attendance and used towards rounding off of your grades after the final exam as part of grade-curving process. A maximum of 2.5 points will be given to a student that has not missed any class and this will be prorated accordingly. However, students having more than 5 absences will not be given any additional points (or grades will not be curved for these students).*

BAEN 414/614
RENEWABLE ENERGY CONVERSIONS
CLASS LECTURE SCHEDULE
Fall 2015

Week	Class	Date	Topic	Read
1	1	9-01-15	Introduction to Renewable Energy Conversion (L1)	Lecture 1
	2	9-03-15	Biodiesel (L2)	Chapter 5
2	3	9-08-15	Bioethanol (L3)	Chapter 6
	4	9-10-15	Biogas (L4)	Chapter 7
3	5	9-15-15	Pyrolysis (L5)	Chapter 8
	6	9-17-15	Gasification (L6)	Chapter 9
4	7	9-22-15	Combustion and Sustainability of Biomass (L7)	Chapter 10
	8	9-24-15	Review for Exam 1	Ch 1-10
5	9	9-29-15	Exam 1	Ch 1-10
	10	10-01-15	Review of Exam 1 Biomass Conversion	Ch 1-10
6	11	10-06-15	Solar Energy 1 (L8)	Chapter 11
	12	10-08-15	Solar Energy 2 (L9)	Chapter 13
7	13	10-13-15	Wind Energy 1 (L10)	Chapter 14
	14	10-15-15	Wind Energy 2 (L11)	Duffie, et al.,
8	15	10-20-15	Hydro Power (L12)	Manwell, et al.,
	16	10-22-15	Hydraulic Ram (L13)	Handouts
9	17	10-27-15	Review for Exam 2 Solar, Wind, Hydro and etc.	Ch 11-14, HO
	18	10-29-15	Exam 2	Ch 11-14, HO
10	19	11-03-15	Review of Exam 2	Ch 11-14, HO
	20	11-05-15	Tidal Energy (L14)	Handouts
11	21	11-10-15	Geothermal Energy (L15)	Handouts
	22	11-12-15	Fuel Cells (L16)	Handouts
12	23	11-17-15	Wave Energy (L17)	Handouts
	24	11-19-15	Salinity Gradient and Fusion Technology (L18)	Handouts
13	25	11-24-15	Ocean Thermal Energy Systems (L19)	Handouts
	26	12-01-15	Review for Exam 3	Handouts
14	27	12-03-15	EXAM 3:Tidal, Geothermal, Fuel Cells, Wave	Handouts
		12-02-15	Field Trip to Commercial Biofuels Facility	
	28	12-08-15	Review of Exam 3 and for Finals (Last Day of Classes)	Handouts and Textbook

Notes: HO=handouts

**BAEN 414/614
RENEWABLE ENERGY CONVERSION
LABORATORY SCHEDULE**

Week	Date	Topic	Ref.
1	9-02-15	Exercise #1 Energy Conversion Efficiency Calculations	
3	9-09-15	Exercise #2 Biodiesel Production Exercise	Ch 5
4	9-16-15	Exercise # 3 Bioethanol Production Exercise	Ch 6
5	9-23-15	Exercise # 4 Biogas Production Exercise	Ch 7
6	9-30-15	Exercise # 5 Pyrolysis Exercises	Ch 9
7	10-07-15	Exercise # 6 Gasification Exercises	Ch 10
8	10-14-15	TAMU Central Utility Plant Tour	
9	10-21-15	Exercise # 7 Solar Energy	Duffie
10	10-28-15	Exercise # 8 Wind Energy	Manwell
11	11-4-15	Exercise #9 Hydro Power Calculations	Handouts
12	11-11-15	Exercise # 10 Tidal Energy Exercise	Handouts
13	11-18-15	Exercise #11 Geothermal Energy Exercises	Handouts
14	11-25-15	Project Presentation for Graduate Students	
15	12-02-15	Exercise # 13 Scheduled Field Trip	

EXAM Schedule

EXAM 1	Tuesday	29 September 2015	Lecture Class: Coverage: Biodiesel, Bioethanol, Biogas, Pyrolysis and Gasification
EXAM 2	Thursday	29 October 2015	Lecture Class Coverage: Solar, wind, hydro power, tidal and others
EXAM 3	Thursday	03 December 2015	Lecture Class Coverage: Other renewables: geothermal, fuel cells, salinity gradient, tidal and wave energy, etc.
FINALS	Monday	14 December 2015	1-3 pm Lecture Room Coverage: All topics.