ARE 440: SOLAR ENERGY IN BUILDINGS

Course Outline

Course	:	Solar Energy in Buildings ARE 440
Semester	:	2007-71
Instructor	:	Sabeer Hamid
Office	:	19-331
Tel.	:	1907
Office Hours	:	As Posted
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Course Timings:		As organized
Location	:	19-450

1. Course Description

Principles of solar energy collection, conversion, storage and distribution are covered in this course. Topics such as solar water heating and cooling applications, their components and systems in addition to Passive solar strategies and concepts of sustainable architecture and also highlighted in this course.

2. Course Objective

The course introduces students to the applications of solar energy in buildings as an alternative source of energy for modern buildings. The course aims at enhancing the students understanding on solar energy availability, collection and potential utilization of solar energy in improving the indoor environmental quality of built-up spaces. Concepts of solar energy utilization in an environment friendly manner and their integration in the design of modern buildings are highlighted. Computer application for modeling buildings for design and estimation are also introduced.

Course Objective(s)	Related To Program Objective
• Introduce students to solar applications in buildings by enhancing their background on solar energy availability, collection and potential utilization in heating and cooling buildings.	**#1**
• Develop design skills and estimation of solar energy availability, collection and potential utilization of solar energy in improving the indoor environmental quality of the built-up spaces.	**#2**
• Enhance recognization of solar energy as an alternative energy source, and be awaire of the economic and technical limitations of its application's.	**#2**
• Identify and equip students with the ethical responsibilities of conserving energy and utilizing alternative sources of energy in professional practice in accordance to the social and global environmental requirements.	**#3**

3. Course Outcomes

Course Outcomes	Program Outcome
• Be able to apply knowledge of mathematics, science and engineering principles that are fundamental to the applications of Building Environmental Control and solar energy utilization in buildings. [**ABET, a**]	**1.1**
• Be able to utilize solar energy applications or components that run or complement conventional systems in the design of building systems. [**ABET , c**]	**2.2**
• Be able to recognize energy issues, understand, and deal with the impact of Solar engineering solutions in a global and societal context [**ABET, h**]	**3.3**
• be aware of emerging technologies and contemporary issues on the subject. [**ABET, I**]	**3.4**

4. Course Syllabus

- **Introduction:** The sun, Sun and earth motion, Nature of solar energy, Extraterrestrial radiation.
- **Solar Radiation:** Measurement of solar radiation, Solar radiation data, Attenuation of solar radiation, Estimation of average solar radiation, Estimation of clear sky radiation, Total and average on site radiation.
- **Radiation Characteristics of Building Surfaces:** Absorption and emittance, Reflection from surfaces, Absorbance, emittance and reflection combined.
- **Solar Radiation Calculations:** Sol-Air temperature, Shading calculations, Radiation of building surfaces, Amount of absorbed radiation, Quantitative analysis of solar radiation, Solar gain and contribution to cooling load.
- **Solar Collectors:** Type of collectors, Theory of flate plate collector, concentrating collectors, Performance of collectors.
- **Thermal Energy Storage:** Solar energy storage process systems, Water storage, Packed-bed storage, Chemical energy storage, Temperature stratification, Heat losses from storage, Heat exchangers.
- **Passive Solar Architecture:** Concepts of Passive design, Direct & indirect gain, Examples of passive solar applications.
- **Solar Heating and Cooling:** Over view of solar heating and cooling
- **Other Topics:** Photovoltaic energy in buildings, applications and case studies

5. Course Evaluation

Break-up of course evaluation

Assignment and Participation	20%
Mid term Exam	25%
Final Exam	30%
Term Paper	25%

6. Textbook

Goswami D.Y., Kreider, J. and Kreth F., Principles of Solar Engineering, 2nd Edition. Taylor & Francis, USA 2000.

References:

1. Duffie, J and Beckman, W., Solar Engineering and Thermal Processes, John Wiley and Sons, ISBN 0-471-050660.
2. Kreider, J. and Dreith F. Solar Heating and Cooling Active and Passive Design, 2nd Edition.
3. Conference Proceedings & Journals (e.g. Journal of Solar Engineering)
4. Related information on the internet and preferred links.

Note:

- As engineering students and future professionals, students are required to be responsible, attentive in class and be present in all the classes. ***A class missed is knowledge lost***. All the students should be present in class before the instructor arrives and thus minimize the wastage of time. Attendance will be taken as the class begins and will not be repeated.
- Two un-excused absences will result in a warning letter. Further absence requires the student to withdraw from the course (W) or (DN) will be reported to the registrar office.
- Late submission of assignments is not expected and will result in reduced grades.
- *To achieve maximum from this course and do a good job, you are expected to put extra efforts and time at your own convenience.*

Good Luck