JEFFERSON COLLEGE
COURSE SYLLABUS

HRA130
SOLAR HOT WATER SYSTEMS

3 Credit Hours

Prepared by:
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September 25, 2013

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HRA130 Solar Hot Water Systems

I. CATALOGUE DESCRIPTION

A. Pre-requisite: Reading Proficiency

B. 3 Semester Hours Credit

C. Solar Hot Water Systems will expose students to solar hot water theory designs and installation through hands-on projects, experiments, and theory. (S,F)

II. EXPECTED LEARNING OUTCOMES/CORRESPONDING ASSESSMENT MEASURES

<table>
<thead>
<tr>
<th>Students will define solar hot water theory</th>
<th>Quizzes</th>
<th>Exams</th>
<th>Homework</th>
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<tr>
<td>Differentiate between different solar designs</td>
<td>Quizzes</td>
<td>Exams</td>
<td>Homework</td>
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<tr>
<td>Design solar systems and measure their efficiencies</td>
<td>Quizzes</td>
<td>Lab Exercises</td>
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<tr>
<td>Practice solar principles by experimentation with solar trainer</td>
<td>Lab Exercises</td>
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III. OUTLINE OF TOPICS

A. History, Design, and Basic Components
   1. History
   2. Collectors
   3. System types
   4. Storage systems
   5. AC and DC pumps
   6. Control issues

B. Vented and Non-Vented Gravity Drained Back Systems
   1. Basic components
   2. Piping collector design requirements
   3. Static head pressure
   4. Pump selection
   5. Collector installation
6. Reservoirs and heat exchangers
7. Float meters and gauges
8. Pump systems
9. Control functions

C. Pressurized Glycol Antifreeze Systems
   1. Unique requirements
   2. AC pumps
   3. AC controls
   4. PV modules
   5. DC pumps
   6. Thermosiphon heat exchangers
   7. Glycols as heat transfer fluids

D. Solar Thermal Collectors
   1. Evaluation
   2. Evacuated tubes
   3. Flat plate collectors
   4. Installation

E. Savings and Performance Estimates
   1. Savings and performance as an investment
   2. Myths and misinformation
   3. Maximizing system efficiency
   4. Real world testing of systems
   5. Computer modeling
   6. Making an informed decision

F. Passive Solar Systems
   1. ICS and thermosiphon systems
   2. Limitations due to freezing and scaling
   3. Weight and installation issues
   4. Time of day issues for extracting heat from ICS systems
   5. Backup power for thermosiphon systems
   6. Pumping passive systems to a storage tank
   7. Thermosiphon systems with heat exchangers (limited climate zones)
   8. Freeze protection: Thermal dribble valves
G. Active Direct Open Loop Systems
   1. Freeze damage potential
   2. Heat loss, reverse therosiphon, from storage
   3. Water quality issues
   4. Draindown systems

H. System Components
   1. Type of pipe and fittings for high temperatures and exposure to oxygen
   2. Insulation and R-value as related to pipe diameter and esthetics in installing insulation
   3. Proper installation techniques for high temperature and UV light
   4. Hot water expansion tanks
   5. Water chemistry and high temperature effects on storage tanks
   6. One-tank vs. Two-tank systems
   7. Making storage tanks last

I. System Controls, Monitoring, Testing and Trouble Shooting Systems, and Components
   1. Test 10 and 20 watt PV modules for voltage and amps
   2. How to conduct a hot/cold sensor test on site
   3. Mechanical aquastats’ control functions
   4. Infrared cameras and their appropriate use
   5. How to monitor the close approach temperature to evaluate heat
   6. Types of sensors and understanding how to prevent electronic interference with sensors
   7. Measuring flow rates, daily BTU measurements, remote displays, and data storage
   8. Packaged systems; advantages and disadvantages

J. Solar Site-Survey
   1. Preparing the proper equipment for the site survey
   2. Pre-evaluation with satellite images
   3. Using the solar pathfinder to do a shading and site analysis
   4. Collector orientation effects on performance: Due east or west versus due south
   5. The effects of tilt and orientation during the seasons
   6. Critical threshold temperature’s effect on daily system performance
7. Balancing aesthetics and maximum collector potential
8. Computer programs available for designing systems
9. Tilt spacing calculator

K. Solar Space Heating, Air Conditioning, and Commercial System Design
1. Rules of thumb for system design
2. On-line information and literature available for solar space heating
3. Different means of storage and distribution of the collected energy
4. Parallel systems
5. Air collectors
6. Backup systems and seasonal microclimate effects on the economics of space heating
7. Multiple solar storage tanks with priority controls
8. Solar heating with heat pipe assist
9. Collecting information at the site for potential collector area and storage
10. Recirculation heat losses
11. Integrating large storage tanks into existing or planned backup systems
12. Designing for building occupancy based on daily, weekly, and yearly load demands required at the site
13. Requirements for access

L. Solar Pool Heating Applications
1. Residential and small commercial systems
2. Commercial preheat applications
3. Glazed pool collectors’ performance and longevity
4. Unique ways to locate and orient solar pool collectors
5. Shading issues and combining roof locations
6. Basic control functions and operations
7. Testing controllers and sensors
8. Sizing by surface area
9. The seasonal cost of heating with fossil fuel heaters
10. Evaluating when to use unglazed collectors, flat plate collectors, or evacuated tubes
11. How SRCC and FSEC ratings apply to seasonal applications for heating swimming pools
12. Using flat plate collectors and heat exchangers for indoor pools in cold winter climates
13. Using thermometers to test for performance
14. Variable speed pumps and their controls
15. Proper heat exchangers required for spas and pools
16. Issues involving covers for copolymer collectors
17. Using unglazed pool collectors for use in heating or pre-heating water for commercial and industrial applications

IV. METHOD(S) OF INSTRUCTION

A. Lectures
B. Labs
C. Videos
D. PowerPoints

V. REQUIRED TEXTBOOK(S)


VI. REQUIRED MATERIALS

None

VII. SUPPLEMENTAL REFERENCES

Handouts

VIII. METHOD OF EVALUATION

A. Exams 40%
B. Labs 30%
C. Quizzes 10%
D. Homework 10%
E. Participation 10%

IX. ADA AA STATEMENT

Any student requiring special accommodations should inform the instructor and the Coordinator of Disability Support Services (Library phone 636-481-3169).
X. ACADEMIC HONESTY STATEMENT

All students are responsible for complying with campus policies as stated in the Student Handbook (see College website, http://www.jeffco.edu).

XI. ATTENDANCE STATEMENT

Regular and punctual attendance is expected of all students. Any one of these four options may result in the student being removed from the class and an administrative withdrawal being processed: (1) Student fails to begin class; (2) Student ceases participation for at least two consecutive weeks; (3) Student misses 15 percent or more of the coursework; and/or (4) Student misses 15 percent or more of the course as defined by the instructor. Students earn their financial aid by regularly attending and actively participating in their coursework. If a student does not actively participate, he/she may have to return financial aid funds. Consult the College Catalog or a Student Financial Services representative for more details.

XII. OUTSIDE OF CLASS ACADEMICALLY RELATED ACTIVITIES

The U.S. Department of Education mandates that students be made aware of expectations regarding coursework to be completed outside the classroom. Students are expected to spend substantial time outside of class meetings engaging in academically related activities such as reading, studying, and completing assignments. Specifically, time spent on academically related activities outside of class combined with time spent in class meetings is expected to be a minimum of 37.5 hours over the duration of the term for each credit hour.