Homework #9 (group) – Thursday, April 19 by 4:00 pm

5290 exercises (individual) – Thursday, April 19 by 4:00 pm

extra credit (individual) – Tuesday, April 24 by 4:00 pm

Readings for this homework assignment and upcoming lectures

- Review lecture notes:
  - Part 11a. Solar Energy - Insolation
  - Part 11b. Solar Energy - Collectors
  - Part 11c. Solar Energy - Storage
  - Part 12. Solar Energy - Photovoltaics
- Review Appendix M. Solar Constants (for Northern Latitudes)
- Review Appendix N. Solar Position and Irradiation Values
- Review Appendix O. Variation of Solar Radiation with Latitude

Homework Submission

- For this assignment, the 4200-portion of the homework is to be worked as a group assignment and submitted as a group in class or by dropping off at my office (room 905). If you use EES for this assignment, then print a copy of the code and solution and include with the homework.
- MEEM 5290 problems are always to be worked and submitted individually.
- Extra credit exercises are always to be worked and submitted individually.
- **At the end of each problem, rank your confidence in the answer from 1 to 5; 5 being very confident and 1 being 'a guess'.**
- Include the course number (MEEM4200, MEEM5290) in the subject line of any email correspondence.

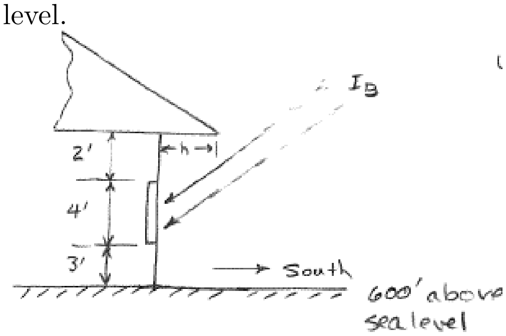
Homework #9 - due Thursday, April 19 by 4:00 pm

1. Calculate the sun's altitude and azimuth angles at 50° N at 9:00 a.m. apparent sun time on July 21.

2. For exercise 1, find the angle of incidence, θ, for a surface facing east-southeast with an inclination of:
   (a) 0° (horizontal),
   (b) 60° from horizontal, and
   (c) 90° (vertical).

3. A solar collector is designed to track the sun so that the collector surface is always perpendicular to the sun's rays. The collector is located at 47°N and 88°W.
   (a) Determine the tilt and azimuth angles of the collector necessary for proper tracking at 9:00 am, local time on May 10th.
   (b) Determine the combined beam (direct) and diffuse-scattered solar insolation if the sky is clear at the same time and date.

4. What should the overhang h be so that the south-facing window is shaded at solar noon on June 21? The house is located in Houghton, Michigan at an elevation of 600 feet above sea level.



Homework #9 – 5290 only

5. The west wall of a red-brick building is located at 35 degrees North latitude and 117 degrees West longitude. Evaluate the combined absorbed beam and diffuse-scatted solar energy flux at 6:00 pm daylight savings time on August 15 for a clear sky.

6. A 300-ft-long 6-ft-wide parabolic trough concentrator receives normal solar insolation of 905 W/m^2. A pipe at the focal line receives 450 lbm/hr of water at 200 psia and 75 °F. The water exits at 180 psia. The parabolic trough has reflective losses of 5%.
   (a) Calculate the temperature of the water at the exit. Is the water at the exit subcooled, saturated, or superheated?
   (b) At this same solar insolation, what should the flow rate be so that the water exits as saturated liquid?
   (c) What should the flow rate be if the exit temperature is to be limited to 200 °F?