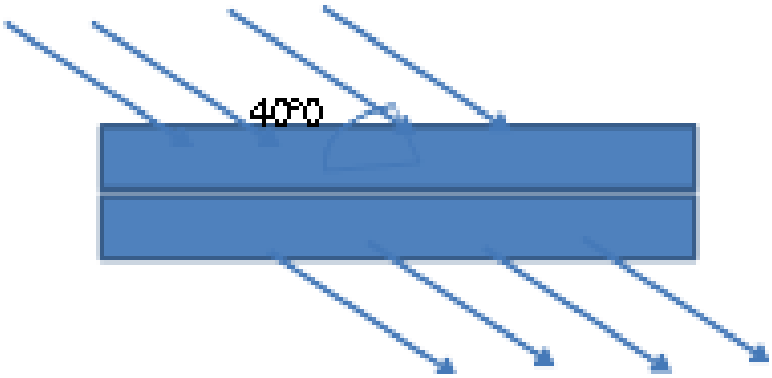
WORKSHEET FOR SOLAR ENERGY

1. Describe the energy source of the sun and the properties of sun light that it radiates.
2. Describe movement of the sun on the sky for a day at 21 March and 1 June.
3. Radiation reaching to the earth is changing throughout a year. Why? What is the level of this change? When is it higher in a year? What is the value of solar constant?
4. At Ankara (40N,33 E); what is the solar time corresponding to 10:00 AM and 13:30 PM, at April 1. Show your calculations. (Similar to Exp.1.5.1)
5. Define declination, zenith angle, elevation angle and solar azimuth angle.
6. Calculate the angle of incidence of beam radiation on a solar collector surface located in Ankara, at 10:45 solar time, on April-1. The surface is tilted 45 degrees from the horizontal towards south. (Similar to Exp.1.6.1)
7. What is pyranometer & phreheliometer. Please compare their internal structure and mention their difference. Why do you use them?
8. Describe the ways for heat loss for a flat plate thermal collector. What is the reason for multiple glass covers in front of the collector?
9. Assume that sun is a blackbody at 5777K.
    a. Calculate the wavelength at which the maximum monochromatic emissive power occurs.
    b. What is the energy from this source that is in the spectrum range of 0.38 micron- 1.1 micron (Exp. 3.6.1)
10. The solar collector surface and its glass cover are spaced 20 mm apart from each other. The emittance of the plate is 0.10 and its temperature is 70 C. The emittance of the of the glass cover is 0.88 and its temperature is 40 C. If the convective heat transfer coefficient between two plate is 4.8 W/m2.K, then estimate the total heat transfer between two plates.
11. Define absorbtance, emittance, reflectance of a surface. What is selective surface. Draw a sample absorbtance graph for a selective surface.
12. Describe selective surface . Why we use them for solar-thermal applications?
13. For the selective surface shown in the figure, calculate the absorbtance for blackbody radiation from a source at 5777K and the emittance at surface temperatures of 150 C and 500C. (Exp.4.8.1)
14. For the glass shown in the figure, calculate the transmittance of light. Assume that glass does not have any absorption. (n=1.52)



15. If the efficiency of the solar panel is 20%, the output voltage is 24V and fill factor is %75, what is the generated current?

16. Describe the working principle of a Silicon Solar Cell.

    a) How the solar cell generates electricity? Describe n/p doping, depletion region concepts.

    b) Describe the meaning of Fill Factor. How do you calculate the fill factor? What can be the reasons of bad fill factor behavior?

    c) A solar panel has an area of 0.5 m^2 and illuminated with an irradiation of 1000W/m^2. Its open circuit voltage is 24 V and Short Circuit Current is 5.5 A. If the FF of the solar panel is 78%, then calculate the efficiency of the solar panel.

17. A photovoltaic solar collector with an area of 2 m2 is tracking the sun for 8 hours on a sunny day. Assume that, the solar flux on the collector is constant through the day as 1000W/m2. PV Solar collector properties are:

    FF: %75, Efficiency: %18.2
    V (MPP, nominal) = 28 V
    V (Open Circuit) = 32 V

    a) What is the total amount of energy converted to electricity?

    b) Assume a reasonable price for the cost of electricity and then calculate the value of electricity ($) produced for whole day.

    c) Calculate the generated current and Short Circuit Current.