Problem Sheet No 01

Question No 1

A central receiver solar thermal power plant uses 1000 heliostats that have 50 m^2 of reflecting surface each. The steam plant has an overall efficiency of 27 percent and generates 3 MW peak power. Using a reasonable solar energy insolation on the heliostats on a clear sunny day, estimate (a) overall efficiency of the solar power plant and (b) efficiency of energy transmission to the steam in the central receiver, both at peak conditions.

Question No 2

A central receiver solar thermal powerplant uses 1000 heliostats that have 60 m^2 of reflective surface each. The overall efficiency of the plant is 5 percent. The efficiency of the steam powerplant is 30 percent. A constant 20 percent of the incident energy on the receiver is assumed to go to storage during operation. Estimate the powerplant output, in megawatts, at peak conditions. Assume all efficiencies are constant during the day.

Question No 3

Find the altitude and azimuth for sunrise (and the same for sunset) and solar noon for your hometown on your birthday.

Question No 4

Estimate the average incident solar energy for a 2-m^2 flat-plate solar collector for your location (your hometown). The collector is installed at an angle equal to the latitude. (a) For December; (b) for June.

Question No 5

You want an average of 600 kWh/month for a home located in Lahore. How big (power) a PV system should you buy? How much area is needed for the array? clearly mention all your assumptions.

Question No 6

An array (fixed tilt at latitude) of six modules, each 250 W, is connected to the grid through an inverter. Estimate annual energy output for system located in Lahore.

Question No 7

A flat plate collector measuring 2m×0.8m is used for water heating with a loss coefficient 7.69 w/m^2K. The glass cover has transmittance 0.9 and the absorptance of the plate is 0.9. Water enters at a temperature T1 = 40^0C. The ambient temperature is Ta = 20^0C and the irradiance in the plane of the collector is G = 750Wm^{-2}. Calculate the flow rate needed to maintain a temperature rise of 5 ^{o}C. Also calculate collector efficiency.

Question No 8

A central receiver thermal solar powerplant has 2670 heliostats, each composed of 121.2*3.6 m reflecting glass panels. The average solar insolation during 10 h operation is 635 W/m^2. The steam cycle has a 10 MW average output and an overall efficiency of 30 percent, assumed constant. The average power lost in radiation transmission from solar insolation on the heliostats to that received by the steam generator is 35 percent. Calculate (a) the size in cubic meters of storage with 25 percent void rock and with sodium and (b) the number of hours the storage system can run the plant at average output.