Workshop Exercises – Sizing the Array, Battery and Inverter in an Off-grid PV System

1. Total daily energy is 1300 Wh. The typical AC load is 130W. The battery bank must be capable of supplying the daily load for 5 days to a maximum DOD of discharge of 70%. Assume the minimum battery temperature is 25 degrees and that inverter efficiency is 85%. What should be the capacity of the battery?

2. There is no d.c loads and the a.c. daily energy usage is 10,606Wh. The maximum demand is 2824VA.
   a) Select a system voltage
   b) Determine the required battery capacity if you want 5 days' autonomy down to 70% DOD (Assume an inverter efficiency of 90%)
   c) Determine the inverter capacity you require.
   d) Determine the number of modules you require for the worst month based on the information provided below? How many modules in series? How many modules in parallel?

   Information
   You will be using a Yingli 145W module.
   You will be using a PWM solar controller.
   It is a dirty site so the dirt derating is 10%
   Assume the manufacturers tolerance is +- 5%
   The columbic battery efficiency is 90%
   The current at 14V is 8.23.A.

PSH for Site

Month	PSH (kWh/m^2)
January	6.69
February	5.9
March	5.78
April	5.33
May	4.76
June	4.42
July	4.66
August	5.22
September	5.82
October	6.26
November	6.46
December	7.01
Average	5.69

3. You have undertaken a load assessment for a house and determined that the average daily AC energy usage AC for the home is 2800 Wh. The typical AC load demand is 300W.
   For the information provided below, calculate the number of solar modules you will need for the array to meet the daily energy usage for the worst months peak sunhours of 4.42. Calculate the number of parallel strings and the number of modules in each string.

The equipment you have selected has the following characteristics:

- Inverter efficiency is 90%
- System voltage is 24V
- The batteries have an energy (Wh) efficiency of 80%. And a coulombic efficiency of 90%.

- The operating voltage window of the MPPT is between: system voltage +12V DC and 150V DC and is rated for a maximum solar input current of 60 A. The MPPT has an efficiency of 96%. Power rating at 24V is 1800W
- 275 W_p multi-crystalline solar module which has the following characteristics
    - Short circuit current is 9.24 A (at STC)
    - Maximum Power Voltage of 31.4V (at STC)
    - Temperature Co-efficient for power of –0.39%/^oC
    - Manufacturers Tolerance for power is ± 3%
    - Open Circuit voltage (V_{oc}) of 38.4V (at STC)
    - V_{oc} temperature coefficient is -0.29%/^oC

- Transmission efficiency - 99%
- Dirt derating - 95%
- The yearly average daytime ambient temperature for the site is 25 degrees.
  Assume the lowest minimum temperature at the site is 0 degrees.