EE4404 Tutorial Questions on Other Renewable Energy and Economics

1. Describe how a Run-of-the-rive mini hydro power plant works.

2. A Run-of-the-river mini hydro power plant has following operational parameters.

   Water Flow rate = 1000 litres/min
   Height difference between source of water and the location of the turbine/generator = 50 meter
   Length of the PVC pipe = 100m
   Diameter of the PVC pipe = 100mm
   Efficiency of the turbine/generator combined = 50%

   a) What is the power output of the plant neglecting the losses in the PVC pipe?
   b) How much energy will be produced in a month if the PVC pipe friction loss is 20%?

3. Using appropriate diagram and equation, describe the basic operation of a proton exchange membrane (PEM) fuel cell.

4. Draw the typical electrical characteristics of a PEM fuel cell, clearly marking different operating regions.

5. Describe various types of losses in a Fuel cell which reduces its performance.

6. What are the key advantages of Direct Methanol Fuel cell over PEM fuel cell?

7. Describe the key characteristics of Alkaline Fuel cell?

8. What are the key advantages of Fuel cell over fossil fuel based power plants?

9. Describe Electrolysis of water for production of Hydrogen.

10. A wind farm project has fifty (50) 2000-kW turbines with 80-m blades. Capital cost is $100 million and the O&M cost for the first year is $2 million. The O&M cost is escalating at the rate of 5% per year. The project will be financed with a $100 million, 30-yr loan at 8% interest. Turbines are exposed to Rayleigh winds averaging 8.5 m/s. What is LCOE for the wind farm?

11. A photovoltaic system that generates 8000 kWh/yr costs $15,000. It is paid for with a 6%, 20-year loan.
    a) Ignoring any tax implications, what is the cost of electricity from the PV system?
    b) With local utility electricity costing 11¢/kWh, at what rate would that price have to escalate over the 20-year period in order for the levelized cost of utility electricity be the same as the cost of electricity from the PV system?

12. A small business uses 100 kW of power and 24,000 kWh/month during peak period. It uses 20 kW peak power and 10,000 kWh/month during off-peak period. Calculate its monthly electricity bill if:

    a)   Time of Use (TOU) rate schedule is used
       On-peak : 12¢/kWh and Off-peak 7¢/kWh.

    b)   Demand Charge Schedule is used with
       Energy charge 6¢/kWh and demand charge of $9/mo-kW.

13. A commercial customer uses demand charge schedule and consumes 20,000 kWh power month with a peak demand charge of 100kW. The rate schedule used is energy charge 6¢/kWh and demand charge of $9/mo-kW. A sales engineer proposes to install an equipment that would reduce the peak demand to 80kW and increase energy efficiency by 10%. What should be cost of the equipment if the pay-back period is less than 3 years?

14. Two customers use 10,000kWh per month and pay according to a demand charge schedule with energy charge 6¢/kWh and demand charge of $9/mo-kW. One customer has a load factor of 15% whereas the other has a load factor of 60%. What is difference in their monthly energy bills?