1)

Please answer questions below and discuss them in detail,

- How do fuel cells operate?

- What are the main components of PEM fuel cells, their properties and functions?

- What are the critical design parameters of PEM fuel cells?

- What are the performance challenges of designing PEM fuel cells?

- What are the applications of PEM fuel cells? Which platforms are they used?

- What are the advantages and disadvantages of PEM fuel cells compared to batteries and/or power generators?

- What do you think is the future market projection of FCEVs according to different world regions?

2)

Design a 60 kW PEM Fuel Cell (net power) system for an FCEV. The range of the vehicle must be at least 400 km. The average energy consumption of the vehicle is 15.6 kW/100km.

If you need any other numerical data, please use your own and explain them in detail.

Show all your formulas and your assumptions if there are any.

a) Size this fuel cell, share weight and volume information. Draw a sketch, show and name all of your components.

b) Determine the oxidant and reactant feeding needs, and calculate the consumption values (Pressure, mass flow, and stoichiometry) and water produced in ml/min.

c) Create the polarization curve of the Fuel Cell, and calculate the efficiency of the fuel cell at maximum load.

d) Calculate the heat power produced by the fuel cell and design a cooling system for the fuel cell. Give information about coolant mass flow, inlet and outlet temperatures. What should be the difference between the inlet and outlet temperatures?

e) Make a list of the materials you use in the Fuel Cell stack, explain in detail which material you use and why.

f) Identify BOP equipment, and create a bill of materials.

g) Create the P&ID diagram of the fuel cell system

h) Design and size a hydrogen tank for the range requested above, determine what type of tank and safety equipment to use, and explain why.

Note: Battery modules, power electronics and control equipment should not be included in this design study.