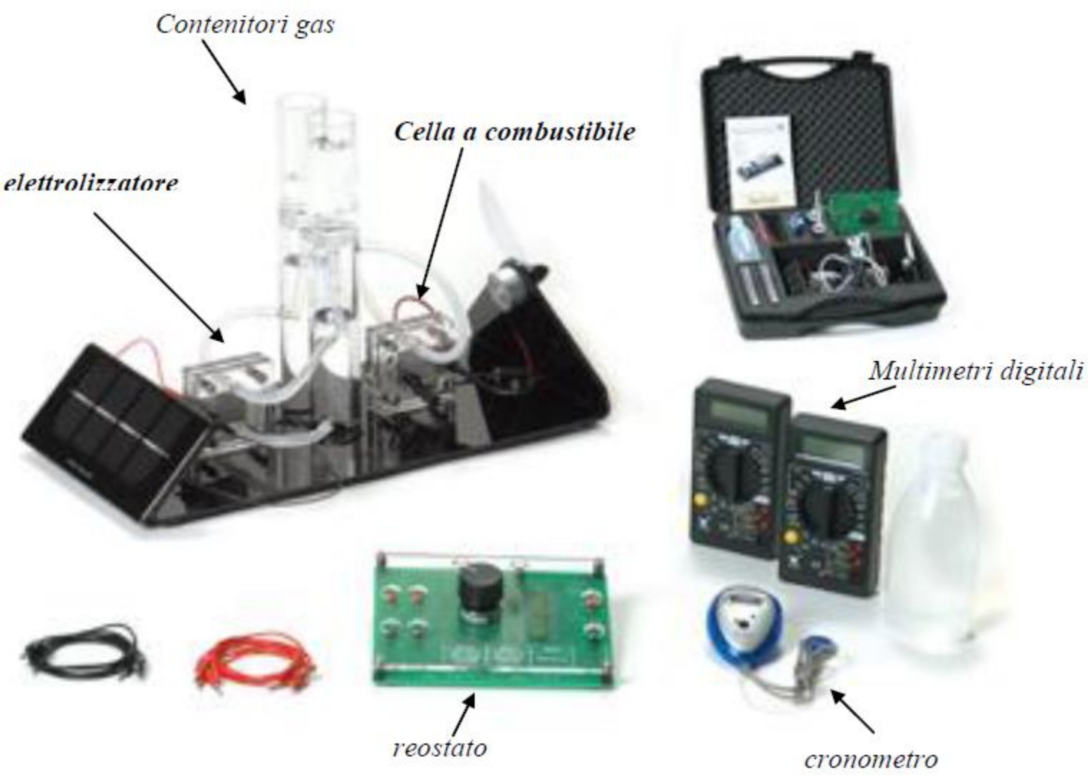
THERMOMECHANICAL MEASUREMENTS FOR ENERGY SYSTEMS

MENR (A.A. 2017-2018)

Laboratory n. 7

1) Fuel Cell

A hydrogen kit for educational experiments is made of the elements indicated in the figure below:



The main characteristics of the components are:

Electrolyzer cell

Electrode area 4 cm^2

Nominal power 1 W

Permissible voltage 0-2 V

	Permissible current 0-1 A
	Maximum H_2 production 4.3 cm^3/min
	Maximum O_2 production 2.15 cm^3/min
Fuel cell	Electrode area 4 cm^2
	Nominal power 400m W
	Generated voltage 0.4-0.98 V
Gas tank	Capacity (volume) 20 cm^3
	Resolution 1 cm^3
Solar cell	Area 90 cm^2
	No-load voltage 2 V
	Nominal current 350 mA_{dc}
	Power (MPP) 500 mW
Fan	Nominal power 100 mW

Bring the apparatus into operation: connect the power supply to the electrolyzer cell, connect the decade resistor and the two digital multimeters to the fuel cell.

a. Define experimentally the **V-I characteristic curve** and the **power curve** of the fuel cell, by setting different resistance load values. Define the maximum power working point of the fuel cell.

b. Define experimentally the **energy efficiency** of the fuel cell with a constant load, measuring the fuel consumption for (at least) two different time instants. Verify the thermodynamic efficiency of the cell changes for the two (or more) measured power values.

c. Define the **Faraday efficiency**, according to the power values previously chosen.

For point b. refer to the formula: $\eta = \frac{W_{electric}}{W_{hudrogen}} = \frac{\bar{V} \cdot I}{Q_{H_2} \cdot H_{low}}$ where Q_{H2} is the volume flow rate and $H_{low} = 10.8 \times 10^6$ J/m^3 is the reaction enthalpy of the fuel.

For point c. refer to the formula: $\eta_{Faraday} = \frac{V_{H2(theoretical)}}{V_{H2(consumed)}}$ where the $V_{H_2(Theoretical)} = \frac{R \cdot I \cdot T \cdot \Delta t}{F \cdot p \cdot z}$ is the Faraday's first law; $R = 8.314 \frac{J}{mol \cdot K}$; I is the current expressed in [A]; T is the reaction temperature expressed in [K]; $F = 96485 \frac{A \cdot s}{mol}$; p is the pressure expressed in [Pa]; z is the number of electrodes for fuel molecule ($z_{H2} = 2$).