Mohamed Boudiaf University (M'sila) Year 2025/2026

Department of Electrical Engineering **Year of study:** 3rd year Bachelor's degree

Option: Renewable Energy and Environment

# Tutorial Session No. 3.

## Exercise 1 :

A passive solar house located at latitude 37°N receives an average solar irradiance of **400 W/m²** on its south façade in winter. The surfaces and parameters are as follows:

- South glazing area: **12 m²**
- Opaque wall area: **30 m²**
- Overall heat transfer coefficient of glazing: $\mathbf{U_v = 2.8\ W/m^2 \cdot K}$
- Overall heat transfer coefficient of walls: $\mathbf{U_m = 0.6\ W/m^2 \cdot K}$
- Average indoor–outdoor temperature difference: **15 °C**

1. Calculate the total heat losses through the south façade
2. Calculate the net solar gains through the glazing (with solar factor g = 0.65)**:**
3. Calculate the net energy balance of the façade (gains – losses)

## Exercise 2 :

A Trombe wall (storage wall behind glazing) has the following characteristics:

- Surface area: A=10 m2
- Thickness: e=0.25 m
- Material: concrete (ρ=2200 kg/m3, cp=880 J/kgK)
- The wall temperature varies from 20°C to 35°C during the day.

**1.** Calculate the amount of heat stored in the wall (in kJ).

**2.** If this energy is released over 8 hours during the night, what is the average available thermal power?

**3.** Discuss the benefit of the Trombe wall for nighttime thermal comfort.

## Exercise 3 :

A municipality plans to equip a residential complex of 50 housing units with solar thermal collectors for domestic hot water and auxiliary heating. **Each dwelling requires on average** 8 kWh/day **of hot water and** 15 kWh/day **of heating.**

Available data:

- Flat-plate collectors with an **average efficiency of 50%**
- **Average annual solar irradiation:** 5.5 kWh/m²·day

**Tasks:**

1. Calculate the total collector area required.
2. Calculate the expected annual energy production (in MWh/year).
3. Estimate the savings in fossil energy if the efficiency of a conventional boiler is 80%.
4. Discuss the possible environmental and urban benefits of such a project ($CO_2$ reduction, energy independence, etc.).