THERMODYNAMIC MODEL OF A HOUSE

The following equation implements the Thermodynamic Energy Equation to describe a simple model of temperature variations inside a house, i.e. the rate of enthalpy change of air inside the house = the rate of net power flow

\[
mc_p \frac{dT_{\text{inside}}}{dt} = \frac{1}{R_{eq}}(T_{\text{outside}} - T_{\text{inside}}) + P_{\text{heating / AC}}
\]

where

- \( m \) - mass of air in the house
- \( c_p \) - specific heat of air at constant pressure \( c_p = 1005 \text{ J/(kgK)} \)
- \( R_{eq} \) - insulation characteristic of the house described by the equivalent insulation rating coefficient, typically in [K/W].

\[
R_{eq} = \frac{R}{A}
\]

where
- \( R \) – average insulation rating of \( m^2 \) of the house [Km²/W]
- \( A \) – area of walls and the roof available to heat transfer.

The task involves the determination of temperature fluctuation inside the house over a three day/night period (72 hours) in the absence of heating and air conditioning, i.e.

- The minimum, maximum and mean temperatures, inside a house.
- The time lag between the maximum temperature inside and outside.
- Give your reasons for the choice of the initial condition.

Later, implement an on-off controlled electric heating and calculate the annual cost of heating for various weather scenarios, followed by an addition of air conditioning.