Initial Value Assumptions

TotalHouseArea = 442 (m^2)
AreaofWindow = 10-400 (m^2) will sweep (start at 10)
AreaofWall = TotalHouseArea - AreaofWindow (m^2)

WallThickness = .1651 (m)
ThicknessofWindow = 0.006 (meters)

MassofAir = 910.175 (kg) House Volume (743 m^3 * 1.225 kg/m^3)

Assume that the inside temperature of the house and temperature of internal walls and windows start at 25 C (298.15 K) based on chemistry standard.
InsideInitialTemperature = 298.15 (K)

AirTemp = $\frac{InsideEnergy}{MassofAir*SpecificHeatAir}$
MassofAir = 910.175 (kg)
SpecificHeatAir = 1000 (J/K/kg)

InsideInitialEnergy = 271368676.3 (J) equation below
910.175 (MassofAir) * 1000 (SpecificHeatAir) * 298.15 (InsideInitialTemperature)
InsideEnergy = determined by ode (J)

InnerWallInitialEnergy = MassofWall * SpecificHeatWall * InsideInitialTemperature
InteriorWallEnergy = determined by ode (J)

InnerWindowInitialEnergy = MassofWindow * SpecificHeatWindow * InsideInitialTemperature
InteriorWindowEnergy = determined by ode (J)

OuterWindowInitialEnergy = MassofWindow * SpecificHeatWindow * OutsideInitialTemperature
OuterWindowEnergy = determined by ode (J)

OuterWallInitialEnergy = MassofWall * SpecificHeatWall * OutsideInitialTemperature
OuterWallEnergy = determined by ode (J)

InteriorWallTemp = $\frac{InteriorWallEnergy}{MassofWall*SpecificHeatWall}$

MassofWall = DensityofWall * AreaofWall * ThicknessofWall/2

ThicknessofWall = 0.1651 (meters) we divide the wall by 2 as we consider the wall as two stocks for the inner and outer

AreaofWall = TotalHouseArea - AreaofWindow (m^2)

DensityofWall = 22 (kg/m^3) based on density of rockwool

SpecificHeatWall = 700 (J/K/kg)

OuterWallTemp = $\frac{OuterWallEnergy}{MassofWall*SpecificHeatWall}$

MassofWall = DensityofWall * AreaofWall * ThicknessofWall/2

ThicknessofWall = 0.1651 (meters)

AreaofWall = TotalHouseArea - AreaofWindow (m^2)

DensityofWall = 22 (kg/m^3) based on density of rockwool

SpecificHeatWall = 700 (J/K/kg)

InteriorWindowTemp = $\frac{InteriorWindowEnergy}{MassofWindow*SpecificHeatWindow}$

MassofWindow = DensityofWindow * AreaofWindow * ThicknessofWindow/2

ThicknessofWindow = 0.006 (meters) we divide the wall by 2 as we consider the Window as two stocks for the inner and outer

AreaofWindow = 10-400 (m^2) will sweep (start at 10)

DensityofWindow = 2500 (kg/m^3) based on density of rockwool

SpecificHeatWindow = 840 (J/K/kg)

OuterWindowTemp = $\frac{OuterWindowEnergy}{MassofWindow*SpecificHeatWindow}$

MassofWindow = DensityofWindow * AreaofWindow * ThicknessofWindow/2

ThicknessofWindow = 0.006 (meters) we divide the wall by 2 as we consider the Window as two stocks for the inner and outer

AreaofWindow = 10-400 (m^2) will sweep (start at 10)

DensityofWindow = 2500 (kg/m^3) based on density of rockwool

SpecificHeatWindow = 840 (J/K/kg)

Assume that the outside temperature of the house and temperature of outer walls and windows starts at external air temperature. This temperature will be 288.706 (K) based on the average summer temperature of Maine.

OutsideInitialTemperature = 288.706 (K)

Our window resistance was determined by the R value of Joseph's standard two pane windows, which are reflective of a standard window type we could see in homes.

WindowResistance = .63 $(\frac{d}{k})$

Based on the resistance of a basic 2x6 sheet of Rockwool.
WallResistance = 19.93 $(\frac{d}{k})$

Resistance = $\frac{1}{Conductivity}$

Conductivity = $\frac{1}{Resistance}$

Resistance = $\frac{d}{k}$

Conductivity = $\frac{k}{d}$

Solar Absorption Equation (Standard Notation)

$$\frac{dU}{dt} = e * I * A$$

e = efficiency of absorption (no units as it is a ratio)

I = insolation (W/m^2)

A = effective surface area (m^2)

Solar Absorption Equation (Our Notation)

$$\frac{dU}{dt} = floorabsorptionefficiency * Insolation * AreaofWindow$$

floorabsorptionefficiency = 0.7

Insolation = 187.5 ($\frac{W}{m^2}$)

AreaofWindow = 10-400 (m^2) will sweep (start at 10)

Convection from Inside to Inner Window (Standard Notation)

$$\frac{dU}{dt} = h * A * (T_\infty - T_S)$$

h = known heat transfer coefficient (W/m^2K)

A = area of surface exposed to convection currents (m^2)

T_∞ = temperature of the surrounding fluid (K)

T_S = temperature of the surface where the heat transfer is happening (K)

Convection from Inside to Inner Window (Our Notation)

$$\frac{dU}{dt} = Inside2InnerWindowh * AreaofWindow * (InsideAirTemp - InteriorWindowTemp)$$

Our h value is based on the typical values chart provided at the start of this unit

Inside2InnerWindowh = 13.5 (W/m^2K)

AreaofWindow = 10-400 (m^2) will sweep (start at 10)

Inside Air temperature is dependent on the levels of energy within the house and thus will change as the energy levels shift. The starting initial value will be 298.15 (K) based on starting energy of the house at standard room temperature.

InsideAirTemp = variable (K)

Temperature of the inner pane of the window is dependent on the amount of energy in the window. We will assume that the initial temperature of the inner window will be standard room temperature 298.15 (K).

InteriorWindowTemp = variable (K)

Convection from Inside to Inner Wall (Standard Notation)

$$\frac{dU}{dt} = h * A * (T_\infty - T_S)$$

h = known heat transfer coefficient (W/m^2K)

A = area of surface exposed to convection currents (m^2)

T_∞ = temperature of the surrounding fluid (K)

T_S = temperature of the surface where the heat transfer is happening (K)

Convection from Inside to Inner Wall (Our Notation)

$$\frac{dU}{dt} = Inside2InnerWallh * AreaofWall * (InsideAirTemp - InteriorWallTemp)$$

Our h value is based on the typical values chart provided at the start of this unit

Inside2InnerWallh = 13.5 (W/m^2K)

AreaofWall = TotalHouseArea - AreaofWindow (m^2)

Inside Air temperature is dependent on the levels of energy within the house and thus will change as the energy levels shift. The starting initial value will be 298.15 (K) based on starting energy of the house at standard room temperature.

InsideAirTemp = variable (K)

Temperature of the inner part of the wall is dependent on the amount of energy in the wall. We will assume that the initial temperature of the inner wall will be standard room temperature 298.15 (K).

InteriorWallTemp = variable (K)

Convection from Outer Window to Outside Air (Standard Notation)

$$\frac{dU}{dt} = h * A * (T_{\infty} - T_S)$$

h = known heat transfer coefficient (W/m^2K)

A = area of surface exposed to convection currents (m^2)

T_{∞} = temperature of the surrounding fluid (K)

T_S = temperature of the surface where the heat transfer is happening (K)

Convection from Outer Window to Outside Air (Our Notation)

$$\frac{dU}{dt} = Outer2AirWindowh * AreaofWindow * (OutsideAirTemp - OuterWindowTemp)$$

Our h value is based on the typical values chart provided at the start of this unit

Outer2AirWindowh = 137.5 (W/m^2K)

AreaofWindow = 10-400 (m^2) will sweep (start at 10)

Outside Air temperature is dependent on the levels of energy within the house and thus will change as the energy levels shift. The starting initial value will be 288.706 (K) based on a assumed constant summer temperature of Maine. We assume no temperature change as 288.706 is an average and our timespan will be short.

OutsideAirTemp = 288.706 (K)

Temperature of the Outer pane of the window is dependent on the amount of energy in the outer pane of window. We will assume that the initial temperature of the outer window will be average Maine summer temperature of 288.706 (K).

OuterWindowTemp = variable (K)

Convection from Outer Wall to Outside Air (Standard Notation)

$$\frac{dU}{dt} = h * A * (T_\infty - T_S)$$

h = known heat transfer coefficient (W/m^2K)

A = area of surface exposed to convection currents (m^2)

T_∞ = temperature of the surrounding fluid (K)

T_S = temperature of the surface where the heat transfer is happening (K)

Convection from Outer Wall to Outside Air (Our Notation)

$$\frac{dU}{dt} = Outer2AirWallh * AreaofWall * (OutsideAirTemp - OuterWallTemp)$$

Our h value is based on the typical values chart provided at the start of this unit

Outer2AirWallh = 137.5 (W/m^2K)

AreaofWall = TotalHouseArea - AreaofWindow (m^2)

Outside Air temperature is dependent on the levels of energy within the house and thus will change as the energy levels shift. The starting initial value will be 288.706 (K) based on a assumed constant summer temperature of Maine.

OutsideAirTemp = 288.706 (K)

Temperature of the Outer part of the wall is dependent on the amount of energy in the outer part of wall. We will assume that the initial temperature (thus also initial energy) of the outer wall will be average Maine summer temperature of 288.706 (K).

OuterWallTemp = variable (K)

Conduction from Inner Window to Outer Window (Standard Notation)

$$\frac{dU}{dt} = -\frac{1}{R} * A * \Delta T$$

R = resistance $(\frac{d}{k})$

ΔT = Hotter - Colder (K)

Conduction from Inner Window to Outer Window (Our Notation)

$$\frac{dU}{dt} = -\frac{1}{WindowResistance} * AreaofWindow * TempdifWindow$$

Our window resistance was determined by the R value of Joseph's standard two pane windows, which are reflective of a standard window type we could see in homes.

WindowResistance = .63 ($\frac{d}{k}$)

TempdifWindow = (InteriorWindowTemp - OuterWindowTemp)

Conduction from Inner Wall to Outer Wall (Standard Notation)

$$\frac{dU}{dt} = -\frac{1}{R} * A * \Delta T$$

R = resistance ($\frac{d}{k}$)

ΔT = Hotter - Colder (K)

Conduction from Inner Wall to Outer Wall (Our Notation)

$$\frac{dU}{dt} = -\frac{1}{WallResistance} * AreaofWall * \Delta T$$

Based on the resistance of a basic 2x6 sheet of Rockwool.

WallResistance = 19.93 ($\frac{d}{k}$)

TempdifWall = InteriorWallTemp - OutsideWallTemp (K)