ASSIGNMENT 1- Modeling a Simple Physics Equation in OMEdit

ASSIGNMENT

Free Fall Motion Model

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1. Assignment Title

Modeling and Simulation of a Free-Fall Motion Using Modelica in OMEdit

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2. Objective

To design and simulate a simple physics-based model using:

• Parameters
• Variables
• Differential equations
• OMEdit simulation

Students will implement the equation of motion for a falling object under gravity.

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3. Physical Background

When an object falls freely under gravity (ignoring air resistance), the governing equation is:

m * a = m * g

Which simplifies to:

a = g

And since:

der(v) = a
der(h) = v

The system is described by two differential equations.

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4. PART A – Model Creation

Task 1: Create a New Model

Open OMEdit.

Create a new model named:

FreeFallModel

Use proper Modelica structure with:

• model declaration
• parameter section
• variable section
• equation section

Task 2: Define Parameters

Declare the following parameters:

1. Gravitational acceleration
2. Initial height of object
3. Mass of object

Explain in comments what each parameter represents.

Task 3: Define Variables

Declare the following variables:

1. Height of object
2. Velocity of object
3. Acceleration

Assign proper start values for height and velocity.

Task 4: Implement Physics Equations

Implement the following relationships:

1. Acceleration equals gravitational acceleration
2. Velocity is derivative of height
3. Acceleration is derivative of velocity

Ensure equations are written in declarative form.

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5. PART B – Simulation

Task 5: Simulate the Model

Simulate from:

Start time = 0
Stop time = 5 seconds

Plot:

• Height vs time
• Velocity vs time
• Acceleration vs time

Task 6: Analyze Results

In your report:

1. Describe how height changes over time.
2. Describe how velocity changes over time.
3. Explain why acceleration remains constant.
4. Identify the time when object hits ground.

Minimum 250 words explanation.

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6. PART C – Parameter Modification

Task 7: Change Initial Height

Increase initial height.

Simulate again.

Answer:

• Does acceleration change?
• Does impact time increase?
• Why?

Task 8: Change Mass

Change mass parameter.

Simulate again.

Answer:

• Does motion change?
• Why does or does not mass affect free fall?

Explain using physics reasoning.