Lab Exercise 9 - SI Units for Patriot Missile Launcher Rotation System (Simplified Academic Model)

This is a famous surface-to-air missile defence system.

We will NOT model weapons — only the **launcher rotation mechanism**, which is a safe electromechanical academic system.

OBJECTIVE OF THIS LAB

Simulate a **missile launcher azimuth rotation system** using:

- DC Voltage Source
- Resistor
- Inductor
- DC Motor (simplified equations)
- Rotational Inertia
- Damper

We will write everything in **text editor mode (no graphical view)**.

PHYSICAL IDEA OF THE SYSTEM

The launcher rotates left or right to aim toward a target.

```
Power → Motor → Shaft → Launcher Platform
```

The motor generates torque.

The platform has inertia.

Friction resists motion.

MATHEMATICAL MODEL

Electrical side:

$$V = R\,i + L\,di/dt + k\,\omega$$

Mechanical side:

$$J\,d\omega/dt = k\,i - b\,\omega$$

Where:

V = applied voltage

i = current

ω = angular velocity

J = inertia

b = damping

k = motor constant

STEP 1: CREATE A NEW MODEL

Open OMEdit

File → New Modelica Class

Name: **PatriotLauncherSystem**

Type: **Model**

STEP 2: COMPLETE MODEL CODE

Paste the following complete code:

```
model PatriotLauncherSystem
  import Modelica.SIunits;

  parameter SIunits.Resistance R = 2 "Armature resistance (Ohm)";
  parameter SIunits.Inductance L = 0.5 "Armature inductance (H)";
  parameter SIunits.Inertia J = 5 "Launcher inertia (kg.m2)";
  parameter Real k = 0.8 "Motor constant (Nm/A)";
  parameter Real b = 1 "Damping coefficient (Nms)";

  SIunits.Current i(start=0);
  SIunits.AngularVelocity w(start=0);
  SIunits.Angle theta(start=0);

  SIunits.Voltage V;

equation
```

```
  // Input voltage (step command to rotate launcher)
  V = if time < 1 then 0 else 24;

  // Electrical equation
  L*der(i) + R*i + k*w = V;
  // Mechanical equation
  J*der(w) = k*i - b*w;
  // Angular position
  der(theta) = w;
end PatriotLauncherSystem;
```

STEP 3: SIMULATION SETTINGS

Simulation → Setup

Start Time = 0

Stop Time = 5

Click Simulate.

STEP 4: PLOT RESULTS

Plot:

• theta (angular position)

• w (angular velocity)

• i (current)