Lab Exercise 3- Navigating OMEdit & Drag-and-Drop Modeling Mechanical and Electrical Systems

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PART A

MECHANICAL MODEL – MASS SPRING DAMPER WITH SINUSOIDAL FORCE

STEP 1: Open OMEdit

Launch OpenModelica → Open OMEdit.

STEP 2: Create a New Model

Click **File → New Model**

Enter model name: **MassSpringElectricalLab**

Click **OK**

STEP 3: Add Mechanical Components

From Library Browser:

Modelica → Mechanics → Translational → Components

Drag the following components into workspace:

- **Mass**
- **Spring**
- **Damper**
- **Fixed**

Arrange them in order:

Fixed → Spring → Damper → Mass

STEP 4: Connect Mechanical Components

Click the **Connect Tool**

Make connections:

```
Fixed.flange → Spring.flange_a
Spring.flange_b → Damper.flange_a
Damper.flange_b → Mass.flange_a
```

STEP 5: Add Force Source

From:

Modelica → Mechanics → Translational → Sources

Drag:

- **Force**

Connect:

```
Force.flange → Mass.flange_b
```

STEP 6: Add Sine Signal Block

From:

Modelica → Blocks → Sources

Drag:

• **Sine**

STEP 7: Configure Sine Block

Double-click **Sine**

Set:

```
amplitude = 100
freqHz = 1
```

Click **OK**

STEP 8: Connect Signal to Force

Connect:

```
Sine.y → Force.f
```

This supplies:

$$f(t) = 100 \sin(2\pi t)$$

STEP 9: Set Mechanical Parameters

Double-click components and set:

Mass:

m = 10

Spring:

```
c = 200
```

Damper:

```
d = 20
```

STEP 10: Check and Simulate

Click:

Check Model

Then:

Simulate

Simulation time:

```
Start = 0
Stop = 10
```

STEP 11: Plot Results

Plot:

```
Mass.s
Mass.v
Force.f
```

Observe damped oscillation.

PART B

ELECTRICAL CIRCUIT DRAG-AND-DROP MODEL

We now create a simple RLC circuit using Modelica Standard Library.

Electrical System Description

Series RLC circuit excited by sinusoidal voltage.

Applications:

• Radar power circuits
• Communication electronics
• UAV onboard electronics
• Defense sensor systems

STEP 12: Create a New Model (or New Diagram)

Click:

File → New Model

Name: **ElectricalCircuitModel**

Click OK.

STEP 13: Add Electrical Components

From:

```
Modelica → Electrical → Analog → Basic
```

Drag:

- **Resistor**
- **Inductor**
- **Capacitor**
- **Ground**

From:

Modelica → Electrical → Analog → Sources

Drag:

- **SineVoltage**

STEP 14: Arrange Components

Place in this order:

SineVoltage → Resistor → Inductor → Capacitor → Ground

STEP 15: Connect Electrical Components

Make connections:

```
SineVoltage.p → Resistor.p
Resistor.n → Inductor.p
Inductor.n → Capacitor.p
Capacitor.n → Ground.p
SineVoltage.n → Ground.p
```

Make sure every circuit has Ground connected.

STEP 16: Set Electrical Parameters

Double-click and set:

Resistor:

```
R = 100
```

Inductor:

```
L = 0.5
```

Capacitor:

```
C = 0.01
```

SineVoltage:

```
V = 10

freqHz = 1
```

STEP 17: Check and Simulate

Click:

Check Model

Then:

Simulate

Set simulation:

```
Start = 0
Stop = 5
```

STEP 18: Plot Results

Plot:

```
Capacitor.v
Inductor.i
SineVoltage.v
```

Observe charging and oscillatory behavior.

Understanding What Happened

Mechanical System Equation (Automatically Formed):

```
m * der(v) + dv + kx = 100 sin(2πt)
```

Electrical System Equation:

```
L di/dt + R i + (1/C) ∫i dt = V sin(2πt)
```

You did NOT manually write these equations.

Modelica generated them from connections.

Concept Comparison

Mechanical domain → Force balance
Electrical domain → Kirchhoff laws

Both use:

```
Acausal connectors
Equation-based modeling
Automatic equation assembly
```