**Solutions:**

### **Q1. Fan Speed Control Based on Temperature and Humidity**

**Objective**: Control fan speed based on two inputs.

**Inputs**:

* Temperature [0–50°C] → {Low, Medium, High}
* Humidity [0–100%] → {Dry, Normal, Humid}

**Output**:

* Fan Speed [0–10] → {Slow, Medium, Fast}

**Steps**:

1. Type fuzzy in MATLAB.
2. Add 2 inputs and 1 output.
3. Assign triangular MFs.
4. Rules:
   * If Temp is High AND Humid is High → Fan Speed is Fast
   * If Temp is Medium AND Humid is Normal → Fan Speed is Medium
   * If Temp is Low AND Humid is Dry → Fan Speed is Slow

**Result**: Use Rule Viewer and Surface Viewer to simulate.

### **Q2. FLC in Simulink for Water Tank Level Control**

**Objective**: Maintain tank level using fuzzy controller.

**Inputs**:

* Error (Desired - Actual Level)
* Change in Error

**Output**:

* Valve Control %

**Steps**:

1. Design FIS with error, change in error as inputs.
2. Use MFs: Negative, Zero, Positive.
3. Output: Valve {Close, Medium, Open}
4. Simulink blocks:
   * Step → Subtract → FLC → Gain → Integrator (Tank)
5. Scope: Observe water level dynamics.

### **Q3. Room Heating Controller**

**Inputs**:

* Room Temp [0–40°C]
* Outside Temp [0–40°C]

**Output**:

* Heater Power [0–100]

**Steps**:

1. FIS with Trapezoidal MFs:
   * Room Temp: Cold, Normal, Warm
   * Outside Temp: Cold, Warm
2. Output: Heater Power {Low, Medium, High}
3. Rules:
   * If Room is Cold AND Outside is Cold → Heater is High
   * If Room is Warm → Heater is Low

**Simulate**: Use Rule Viewer.

### **Q4. Fan Speed Control with Scope in Simulink**

**Same as Q1**, but use:

* Simulink → Fuzzy Logic Controller Block
* Constant Input → FLC → Scope
* Load FIS and run simulation

### **Q5. Smart Lighting System**

**Inputs**:

* Ambient Light [0–100]
* User Preference [0–100]

**Output**:

* LED Brightness [0–100]

**MFs**:

* Light: Dark, Normal, Bright
* Preference: Low, Medium, High
* Brightness: Dim, Moderate, Bright

**Rules**:

* If Ambient is Dark AND Preference is High → Brightness is High
* If Ambient is Bright → Brightness is Low

### **Q6. Braking System in Vehicles**

**Inputs**:

* Speed [0–120 km/h]
* Distance to Object [0–100 m]

**Output**:

* Brake Force [0–1]

**MFs**:

* Speed: Slow, Medium, Fast
* Distance: Near, Moderate, Far
* Brake Force: None, Medium, Full

**Rules**:

* If Speed is Fast AND Distance is Near → Brake Force is Full
* If Speed is Slow AND Distance is Far → Brake Force is None

### **Q7. Washing Machine Time Control**

**Inputs**:

* Dirt Level [0–10]
* Load Weight [0–10]

**Output**:

* Wash Time [10–60 min]

**MFs**: Gaussian

* Dirt: Low, Medium, High
* Load: Light, Normal, Heavy
* Time: Short, Medium, Long

**Rules**:

* High Dirt & Heavy Load → Long Time
* Low Dirt & Light Load → Short Time

### **Q8. Voltage Control in Power System**

**Inputs**:

* Load Demand [0–100%]
* Voltage Drop [0–10V]

**Output**:

* Regulator Adjustment [%]

**Rules**:

* High Load & High Drop → Max Regulation
* Low Load & Low Drop → No Regulation

### **Q9. Air Conditioner Compressor Speed Control**

**Inputs**:

* Indoor Temp [18–30°C]
* Occupancy [0 (No) / 1 (Yes)]

**Output**:

* Compressor Speed [0–100]

**Rules**:

* Occupied & High Temp → High Speed
* Unoccupied → Compressor Off

### **Q10. Traffic Light Timing Controller**

**Inputs**:

* Traffic Density [0–100]
* Time of Day [0–24]

**Output**:

* Green Signal Time [10–120 sec]

**Rules**:

* Peak Hours + High Density → Green Time is Long
* Off-Peak + Low Density → Green Time is Short